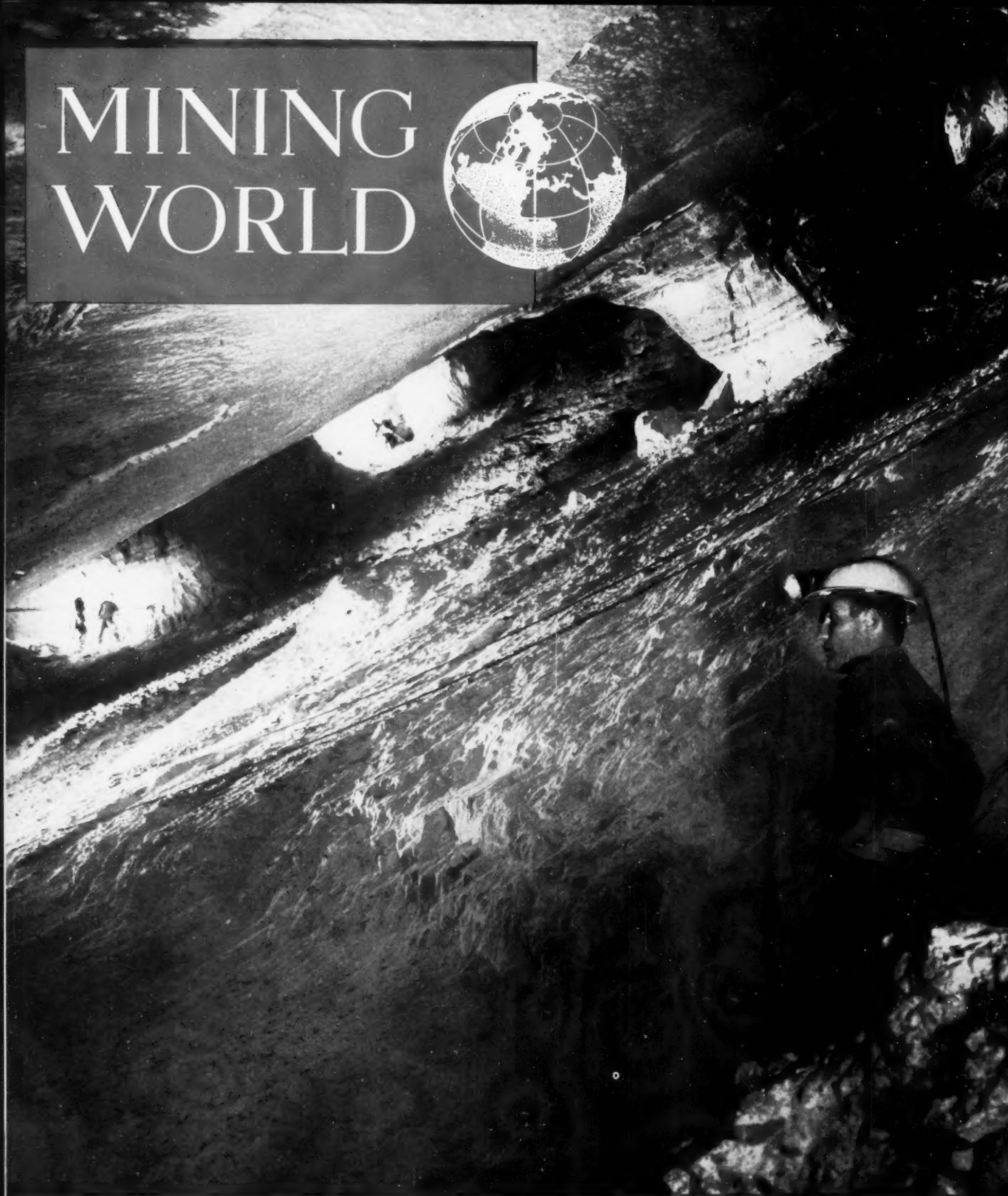


MINING WORLD



Underground potash mining

JULY 1961

Fifty cents

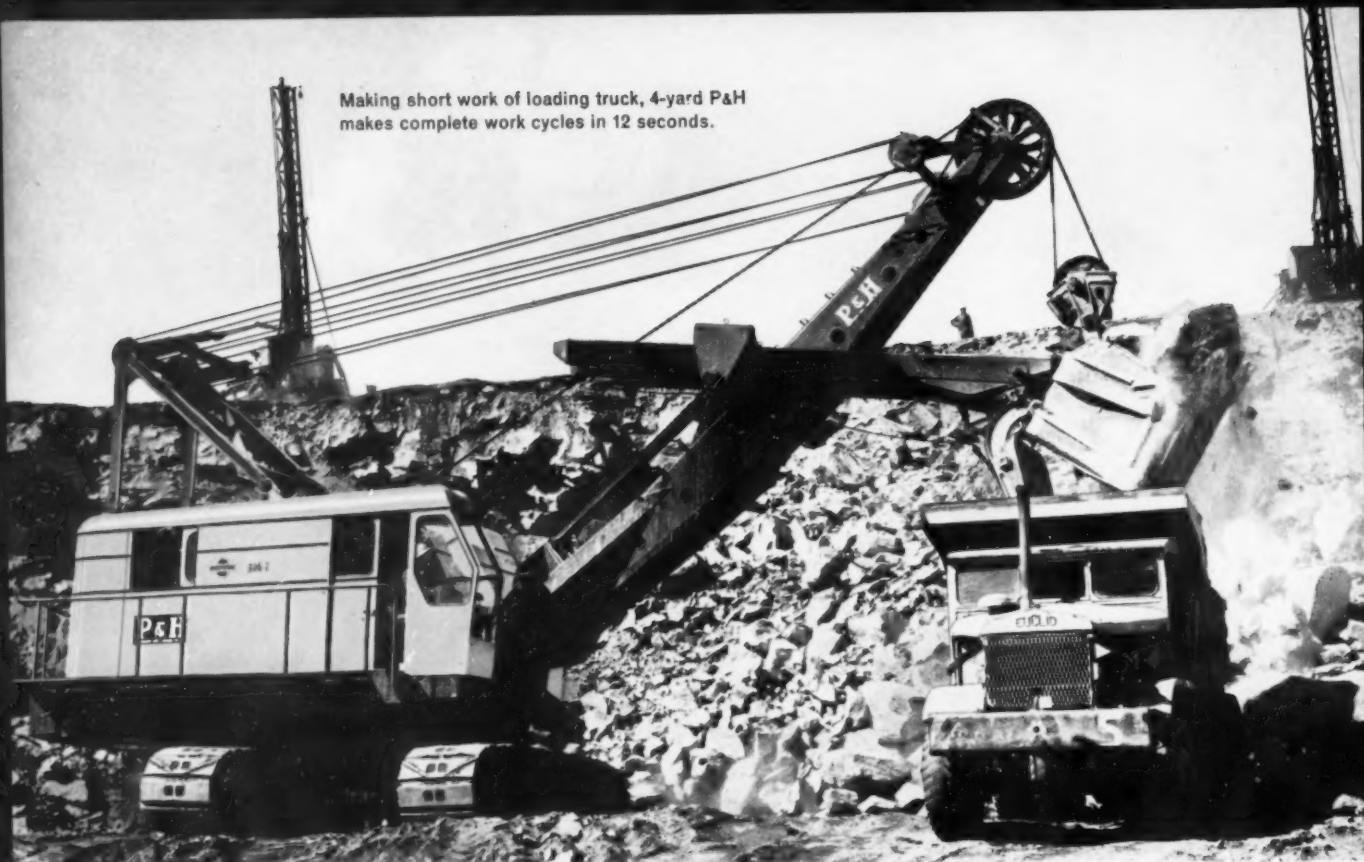
VIBURNUM lead mine catches eyes of industry ► 18

POTASH mining in Sicily is highly mechanized ► 22

AFRICAN Mining Congress great success ► 28

VANADIUM demand causes concern in USA ► 30

Making short work of loading truck, 4-yard P&H makes complete work cycles in 12 seconds.



Magnetorque swingers are the reason . . .

"4 yard P&H out-produces two 2½ yard shovels"

... STOCKBRIDGE STONE COMPANY, Atlanta, Georgia
Division of VULCAN MATERIALS COMPANY

Powerful P&H handles heavy rock with tireless ease as it works 16 hours a day digging and loading shot rock.

J. G. Lambert, Superintendent, has this to say about his operation—*"Our 4 yard P&H shovel, with Magnetorque swingers, accounts for more than half of the yardage produced at our Fortson quarry. It actually produces more than both of our other 2½ yard shovels combined."*

12 to 15 seconds work cycles. Stockbridge Stone supplies aggregate throughout Georgia, Alabama, and to four company-owned plants that manufacture concrete blocks and ready-mix. Of prime importance to them is the speed and dependability with which their shovels can excavate rock and load trucks to keep their processing plants in production. This company reports that their P&H shovel loads 18-ton trucks in 5 or 6 passes with work cycles averaging 12 to 15 seconds.

Edward Pitts, operator of the P&H says that Magnetorque swingers are the reason he gets better than 25% faster work cycles. He points out that Magnetorque swingers, unlike friction-type clutches, never over heat, and are not affected by temperature changes or load size.

P&H works two 8 hour shifts per day. To meet the heavy demand for aggregate, Stockbridge operates their 4-yard P&H shovel on a 16-hour day . . . and they operate in all types of weather, even the heaviest rains. This company has proven to itself that P&H delivers exceptional performance under the most rigorous conditions—steady, fast cycles with no downtime other than normal preventive maintenance.

Another feature, "Bud" Lambert stresses, is the propel brake on the P&H—this brake control gives more productive working time because it eliminates the constant need to "dog" or "undog" the machine with clumsy jaw clutches for every move.

For more information on this job, write for Case History 136.

HARNISCHFEGER P&H
Milwaukee 46, Wisconsin



What does **CARSET** really mean?

Sure it's a trademark for an Ingersoll-Rand rock bit with tungsten carbide cutting edges. But...it also means years of know-how...the experience born of thousands of trials...and frustrations...and hundreds of thousands of dollars spent in searching and perfecting.

It also means selection...and rejection of more materials and shapes and sizes and what have you...than we care to talk about.

It means steadfastness, against experts from without...and from within. It also means criticism from the bargain hunters and die-hards with the do-it-yourself kits.

In short, it means we will continue to give you the best bit that know-how and money can build. If you have not already standardized on the bit that is backed by experience and everything you need for drilling rock...do it now.



*A CONSTANT STANDARD
OF QUALITY
IN EVERYTHING YOU NEED
FOR DRILLING ROCK*



Ingersoll-Rand
227A5 11 Broadway, New York 4, N. Y.



WHY IT COSTS LESS TO OWN A CAT GRADER

Most motor graders *look* pretty much alike, no matter who makes them. They handle similar jobs, too, and it isn't always easy to *see* any big difference in the way they handle them. In fact, the manufacturer's suggested prices usually are not greatly different for machines of nearly equal specifications—regardless of the “deal” that may be offered a buyer. But *used* motor graders vary considerably in price. Why?

The Buyer Determines Price

A used machine is priced at what the buyer is willing to pay . . . it's a measure of what *he* thinks is left in a machine. So, with used equipment, the buyer sets the price. This is clearly demonstrated at used equipment auctions. A check of auction prices throughout the country shows, for example, that the Cat No. 12 Motor Grader brings substantially higher prices than comparable machines of other makes—as much as 80% more. (Only machines of the same age, same condition and with similar attachments were compared.) What makes a Cat Motor Grader more desirable than other makes?

A Feature That Affects Cost

Any machine is desirable if it is known to be dependable. This reputation can

only be the result of true quality design and quality construction. The Cat oil clutch is a good example. It was designed and is built to give long, trouble-free life. But, how well does it do it? Let's examine the records of just one Caterpillar Dealer who has 161 oil clutch-equipped motor graders in his territory. His records show that in four years he has sold only \$24.33 worth of parts for motor grader oil clutches! One machine in his territory went 2524 service meter hours without any work on the clutch. Many users report 2000 hours of service before the first adjustment. In 1000 hours of operation only about .0025 inch of wear can be expected—less than the thickness of a human hair. And, since all parts are constantly bathed in oil there is no need for lubrication maintenance. Less wear, less attention mean not only lower total repair costs but more time on the job . . . less down time. Of course, the oil clutch is just one example of many quality features in Cat Graders.

A Look at Total Cost Records

The cost records of private owners and governmental bodies show which machines cost less. For example, an Indiana county keeps individual cost records on their six motor graders, 14 trucks, three loaders and five tractors.

Their records showed that a year-old No. 12 needed only a set of head gaskets and two spark plugs with \$25 labor, while two newer graders of another make needed major engine repairs, new clutches and side shift linkage. One town in New Hampshire reports that in over 20,000 hours, their No. 12 has never had a breakdown that held up work more than three hours. Operating costs—24¢ per hour exclusive of fuel, oil and operator. Comparing a Cat No. 12 to another make (after 3½ years' service), the records of an Arkansas county showed a saving of \$2478.57 in parts and labor for their No. 12.

What's in It for You

Others have proved that Cat Motor Graders cost less in the long run because they are built better in the beginning. Your Caterpillar Dealer has additional facts and figures on low-cost operation of Cat Graders in your area. Ask him for free Cost Record Books so that you can keep individual machine records on your equipment. Prove to yourself that it costs less to own a Cat Grader.

Caterpillar Tractor Co.,
General Offices, Peoria, Ill., U. S. A.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.



Viburnum No. 27 mine in Missouri is the most important new underground lead mine in the United States today because of an efficient combination of men, equipment and ideas 18

Montecatini's San Cataldo potash mine in Sicily, the world's newest potash producer, mines steeply dipping beds by sub-level stoping ... 22

Humorous aspects of a mining education and equipment development are discussed in the satire "Why Didn't I Think of That?" 25

Seventh Commonwealth Mining Congress in Johannesburg, South Africa offered delegates an unparalleled opportunity to see how the mining companies are developing the natural resources of South Africa 28

Vanadium demand abroad is causing concern in the United States. Has a new use for vanadium been developed in Europe? 30

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NO MAJOR REPAIRS IN 25 YEARS*

Sturtevant Construction Assures

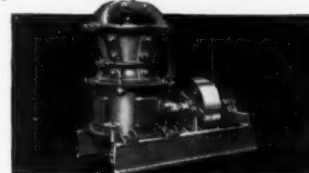
Long Mill Life at Top Loads

Sturtevant crushing and grinding machinery answers the long life top-load production problem for medium to small size plants. Many Sturtevants have been operating above rated capacities for more than 25 years, and *without a major repair*.

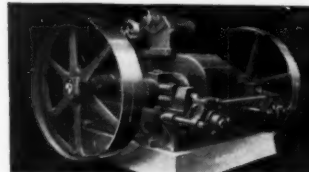
"Open-Door" design gives instant accessibility where needed — makes cleanouts, inspection and maintenance fast and easy. Machines may be set up in units to operate at equal quality and capacity.



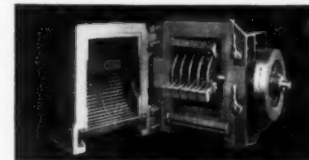
Jaw Crushers — Produce coarse (5 in. largest model) to fine (1/4 in. smallest model). Eight models range from 2 x 6 in. jaw opening (lab model) to 12 x 26 in. Capacities to 30 tph. All except two smallest sizes operate on double cam principle — crush double per energy unit. Request Bulletin No. 062.



Rotary Fine Crusher — Reduce soft to medium hard 3 to 8 in. material down to 1/4 to 1 1/4 in. sizes. Capacities up to 30 tph. Smallest model has 6 x 18 in. hopper opening; largest, 10 x 30 in. Non-clogging operation. Single handwheel regulates size. Request Bulletin No. 063.



Crushing Rolls — Reduce soft to hard 2 in. and smaller materials to from 12 to 20 mesh with minimum fines. Eight sizes, with rolls from 8 x 5 in. to 38 x 20 in.; rates to 87 tph. Three types — Balanced Rolls; Plain Balanced Rolls; Laboratory Rolls — all may be adjusted in operation. Request Bulletin No. 065.



Hammer Mills — Reduce to 20 mesh. Swing-Sledge Mills crush or shred medium hard material up to 70 tph. Hinged-Hammer Pulverizers crush or shred softer material at rates up to 30 tph. Four Swing-Sledge Mills with feed openings from 6 x 5 in. to 20 x 30 1/2 in. Four Hinged-Hammer Pulverizers with feed openings from 12 x 12 in. to 12 1/2 x 24 in. Request Bulletin No. 084.

*Reports Manager W. Carleton Merrill concerning Sturtevant Swing-Sledge Mill at James F. Morse Co., Boston.

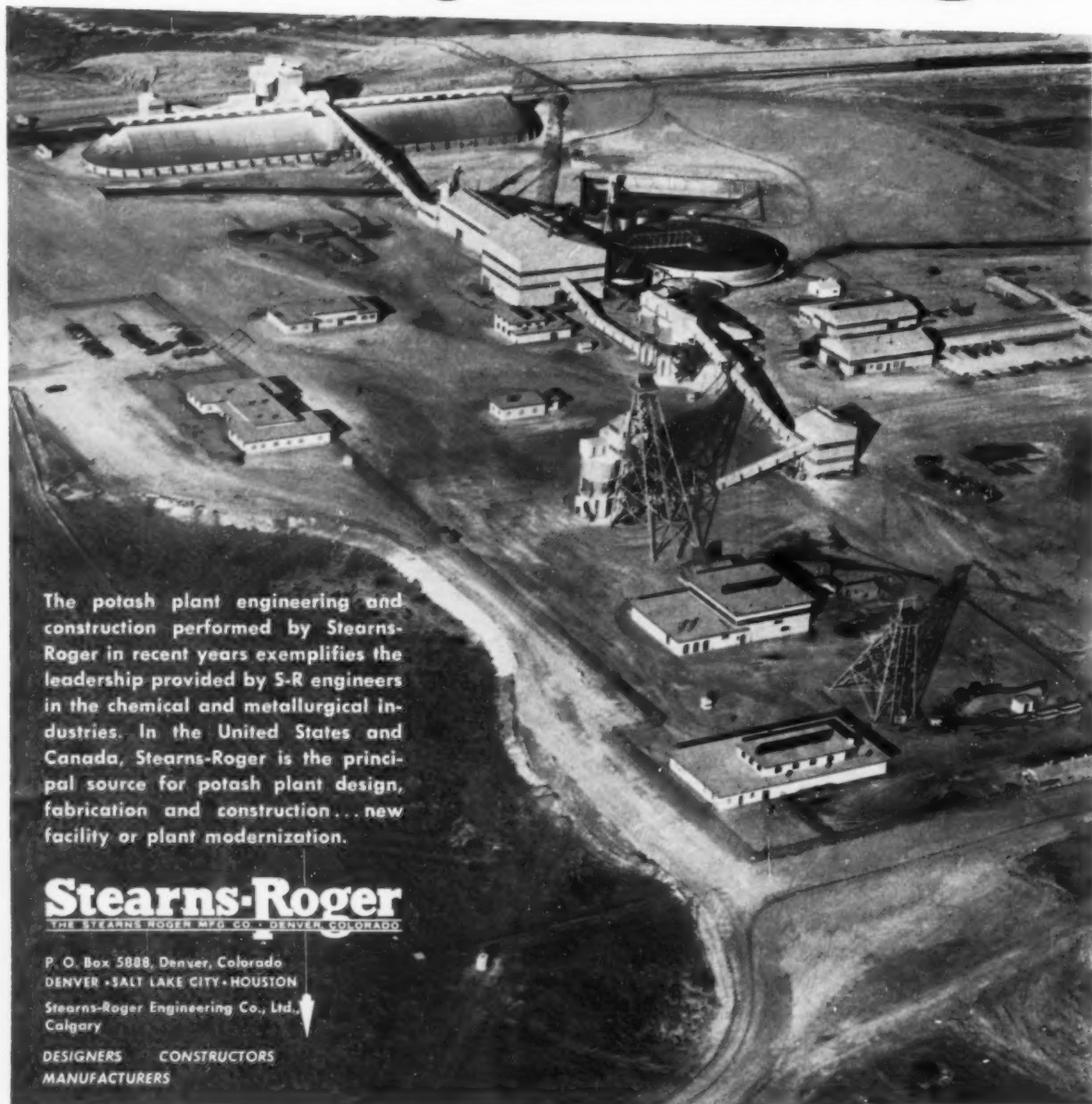
STURTEVANT

MILL COMPANY
157 CLAYTON STREET
BOSTON 22, MASS.

processing plants

for potash

by Stearns-Roger



The potash plant engineering and construction performed by Stearns-Roger in recent years exemplifies the leadership provided by S-R engineers in the chemical and metallurgical industries. In the United States and Canada, Stearns-Roger is the principal source for potash plant design, fabrication and construction... new facility or plant modernization.

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Calgary

DESIGNERS CONSTRUCTORS
MANUFACTURERS

CAPITOL concentrates

GOVERNMENT ACTION AND REACTION AFFECTING MINING



Appeal Made to President Kennedy for Domestic Lead-Zinc Policy . . .

Congressman Walter Baring of Nevada has petitioned President Kennedy for an early recommendation for a lead-zinc policy.

"While I have always stated that a permanent solution to achieve a healthy industry is through protective tariff and established quotas," Baring wrote the President, "our

present policy of reciprocal trades has hurt us to such an extent that I believe some word from you relative to a domestic policy is vital at this time."

Baring, together with 12 other members of Congress, recently introduced a bill providing for a limited, controlled subsidy for each miner of

lead and zinc production up to 2,000 tons of metal produced in a 12-month period. The measure also called for tighter permanent tariffs on the two metals and an additional compensatory tax of 2 cents per pound of manufactured lead and zinc items imported from foreign countries.

New Rules Adopted for Phosphate Allow Two-Year Prospecting Permit . . .

A new prospecting permit-lease system for phosphate has been announced by Secretary of Interior Udall to replace the previous non-competitive lease set-up. Under the new regulations, phosphate prospecting and development will conform to the systems used for coal, sodium,

sulphur and potassium.

The new rules provide for issuance of two-year prospecting permits covering up to 2,560 acres each at an annual rental of 25 cents per acre. The present acreage limitation of 10,240 acres which can be held by any one person or company will con-

tinue to apply. A permit-holder will have exclusive rights to prospect on the area covered by his permit, which may be extended for up to four additional years. If a valuable deposit of phosphate is discovered, the permit-holder will be given the right to lease the land.

Incentive Payment Plans for Gold Meet Opposition From Executive Branch . . .

The Mines and Mining Subcommittee of the House Interior Committee held a hearing last month on the various bills which would authorize federal incentive payments to domestic gold producers.

The report of the Department of Interior stated that "the Executive Branch is opposed to the enactment of any legislation that would establish or imply a second price for gold, different from the \$35 per ounce price now in effect."

The report added: "The payment of incentives of the sort proposed in this bill (H. R. 6375) would result in a situation that gold costing the government \$70 an ounce would be offered at \$35 an ounce to foreign monetary authorities and American industrial users of gold. Enactment

of legislation providing for payment of a subsidy of this sort could lead to uncertainty about the United States price of gold and the stability of the dollar in world markets, and so could result in an increased drain on United States gold reserves. Although the Department of Interior recognized that the bill would be beneficial to gold miners, the Executive Branch has concluded, in view of the paramount national interest in the monetary function of gold, that the enactment of this legislation would not be desirable."

Witnesses who, over a period of years, have testified for various bills to raise the price of gold or to pay a bonus for newly mined gold have made a good deal of capital of the

point that the bonus would furnish a subsidy to copper, lead and zinc producers as well as help gold miners. The general government opinion is that none of the bills so far introduced would induce the opening of sufficient new gold mines to make the payments worth while. It also is the opinion of the Treasury and Interior Department officials that a bonus paid to copper, lead and zinc mines would be a waste of money as far as increasing domestic gold production is concerned because the volume of production of these metals is dependent upon economics entirely separate from the gold problem, and in no way controlled by it. Using a gold bonus to pay a subsidy to copper, lead and zinc mines has no appeal to the government.

New Barter Plan of Agricultural Products for Lead Favors Two Companies . . .

The new program for bartering lead for surplus agricultural products undoubtedly has the merit of exchanging products that may spoil. At the same time, the limitation that the lead must have been mined prior to December 31, 1960 (a provision presumably designed to discourage in-

creasing present production), means that two companies will reap the principal benefits. These companies, Broken Hill of Australia and Consolidated Mining of Canada, are said to hold most of the 60,000 tons which are to be bartered in the form of pig lead. Further, the pig-lead specifica-

tion would prohibit domestic smelting of the concentrate which would have given some domestic employment. If these companies are holding the lead in the form of pig, why not use the funds or credit to build up another stock for us to take off their hands at a later date?



Lima Type 2400 dragline speeds iron ore stripping operations.

Limas dig, strip or load more . . . for less cost!

It takes a rugged breed of men and machines to mine the ores deposited so willfully around the globe by nature. Limas are part of that special breed. For wherever mining jobs call for more digging, stripping and loading capacity . . . at less cost . . . you will find Limas doing more than their share of the work.

Muscled for big jobs

The Lima Type 2400 is muscled for the really big mining jobs—as a variable capacity dragline, 8 cu. yd. shovel, or 110-ton crane. It is mounted on wide and long crawlers for extra ground contact and easy handling. Large-diameter drums are extra wide for increased cable capacity.

Anti-friction bearings reduce wear at all important bearing points. Large

air-operated clutches give instant response to controls. Torque converter increases output, reduces shock loading, prevents engine stall, gives cables longer life, and lowers maintenance.

Lima quality pays

These are only a few of the many quality features that pay off for you with a Lima. As hundreds of mining operators have found, Lima's extra engineering features and built-in quality mean greater tonnage and higher profit.

There is a Lima type and size for every mining operation! Shovels $\frac{3}{4}$ to 8 cu. yds., variable capacity draglines, cranes to 140 tons. Get full information today from your nearest Lima distributor on powered-for-profit Limas—or write to us.



This team of hard working Lima shovels speeds Mesabi Range ore loading. At left, $1\frac{1}{2}$ cu. yd.; at right, $3\frac{1}{2}$ cu. yd.

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CABLE ADDRESS: LIMASHOVEL

LIMA Construction Equipment Division, Lima, Ohio
BALDWIN · LIMA · HAMILTON

Shovels • Cranes • Draglines • Pullshovels • Roadpackers • Crushing Equipment • Asphalt Plants





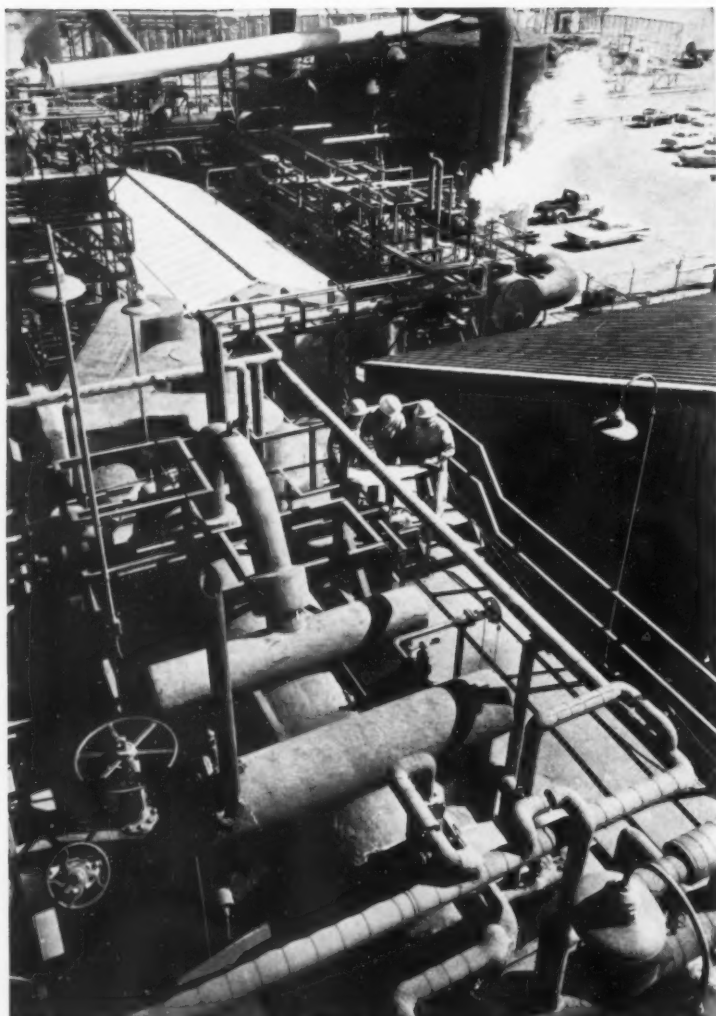
OPEN PIT OR UNDERGROUND — PUT POWER WHERE YOU NEED IT

POWER above ground or at the face—for shuttle cars, hoists or shovels... lighting or communication...tools or blasting—wherever you want power in a mine, think of General Cable first! It's the world's most complete line of wire and cable—and you'll find ample stocks near every mining center. For power where you want it, when you want it — rely on

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GCC
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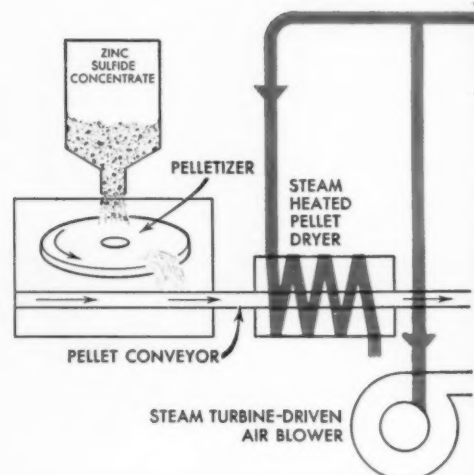
CABLE FOR ANY MINING APPLICATION! ■ Super Service power cables ■ Borehole cable, armored or non-metallic armored ■ High-voltage shielded power cable ■ Portable cable, 600V rating, 3/C or 4/C, Type G, PG, PCG ■ Portable cable, 600V rating, Type W ■ Blasting wire and shot firing cord ■ Communication products



High output is maintained by water-cooled roaster surfaces which keep boiler tubes slag free, reducing down-time in this B&W waste-heat boiler at Sherbrooke Metallurgical Co. Ltd.



Process steam economically dries and heats the zinc sulfide ore pellets after they are formed on this pelletizer.



Integrated, efficient boiler-roaster system provides **HIGH OUTPUT, LOW OPERATING COST PLUS REVENUE FROM**

Working closely with New Jersey Zinc Company and Matthiessen & Hegeler, B&W engineers integrated two B&W waste heat boilers with patented Fluid Column Roasters developed by New Jersey Zinc. The result: a highly efficient integrated boiler-roaster system now in operation at Matthiessen & Hegeler's subsidiary, Sherbrooke Metallurgical Company Limited at Port Maitland, Ontario.

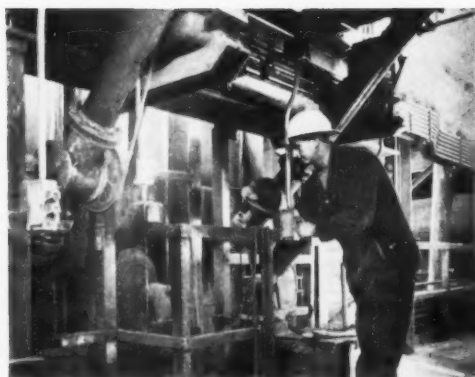
LOW OPERATING COSTS Design of the roaster permits efficient utilization of the "self-burning" characteristic of zinc sulfide ore, eliminating the need for any fuel input except during startup. Process steam generated in the B&W boilers is used to dry the zinc sulfide pellets and drive the fluidizing air

blowers and other auxiliary equipment.

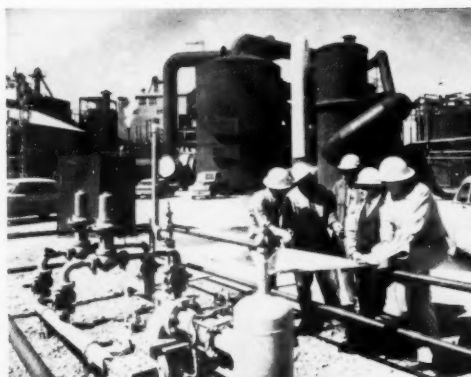
Heat-wasting methods of process temperature control are eliminated by maintenance-free, water-cooled B&W tubular surfaces in the roaster enclosure which replace costly, high-maintenance suspended refractory roofs and flues. It is believed that the waste heat recovery, in pounds of steam per pound of ore roasted, sets a new record.

Erosion is prevented and fluid bed cooling is assured by securing protective blocks to the steam generating tubes below the fluid bed level.

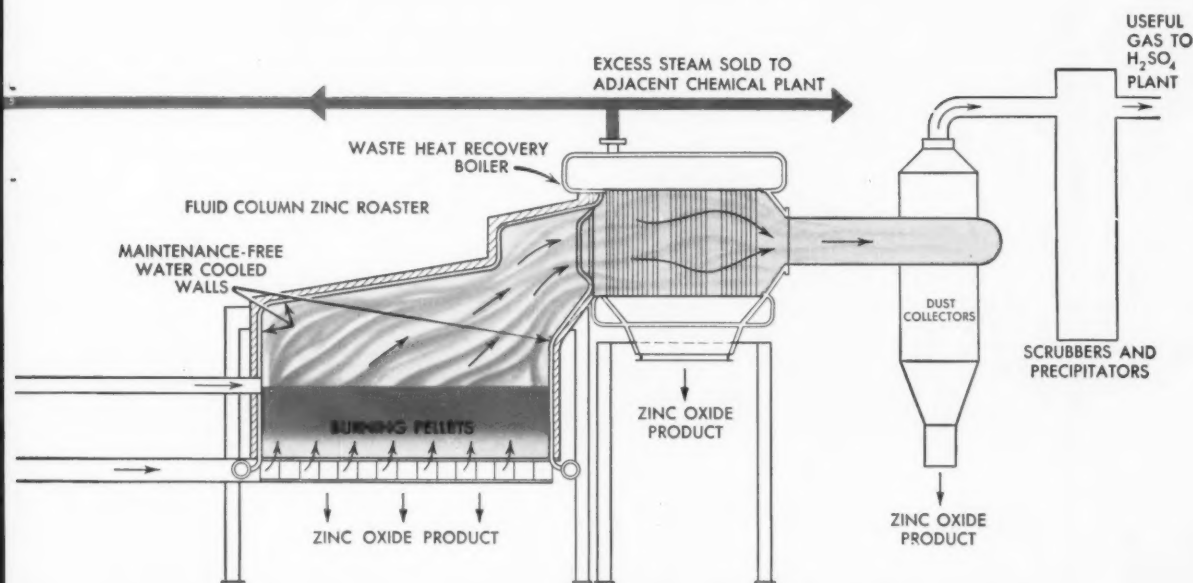
A gas and dust tight enclosure capable of sustaining all process pressure fluctuations is provided with B&W's inner casing design of externally-insulated steel plate welded to the boiler tubes. Canadian



Low operating cost results from self-burning characteristic of ore. Initial fuel firing is provided at start-up by the conventionally fueled burners shown above.



By-product revenue is derived from sale of steam and sulfuric acid to neighboring plants. Recovered SO_2 is converted to sulfuric acid in this acid plant.



BY-PRODUCT RECOVERY *at Matthiessen & Hegeler*

winter weather poses no problems for these outdoor units, as all steel surfaces contacted by roaster gas are maintained at temperatures well above the corrosion level.

BY-PRODUCT SULFUR RECOVERY REVENUE SO_2 gas created in the roasting process is recovered and converted to sulfuric acid. Additional revenue is realized through the sale of this by-product.

These two new units are the 22nd and 23rd B&W boilers purchased by Matthiessen & Hegeler since 1873.

With advanced engineering developments such as this, B&W — in cooperation with industry throughout the world — is applying the latest engi-

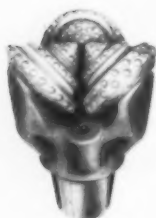
neering developments to reduce processing costs and increase the recovery of useful energy. For more information on effective recovery of waste heat, write for Bulletin G-88. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.



B&W

ME-105

THE BABCOCK & WILCOX COMPANY
BOILER DIVISION



Type HH
ROTA-BLAST
Formerly type RG-2JS
for extremely hard
abrasive rock
(Taconite, quartzite)



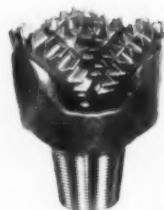
Type H
ROTA-BLAST
Formerly type W7R
for hard rock
(Siliceous limestone,
dolomite, sandstone,
granite)

HUGHES ROTA-BLAST BITS **are engineered for mining**

Faster blast-hole drilling means more production, lower costs. In areas where blast hole drilling is the toughest, Hughes "Rota-Blast" rock bits and rotary drilling techniques, developed in close co-operation with operators and drill manufacturers, are increasing footage and penetration rate as much as 100% and more.

Your Hughes representative can recommend the "Rota-Blast" bit best suited to your operation, and is also qualified to offer you assistance in your drilling program. Back of his recommendations are more than a half-century of specialized rotary rock bit experience, and the world's largest rock bit manufacturing plant.

HUGHES
industrial products
HUGHES TOOL COMPANY • HOUSTON, TEXAS



Type M
ROTA-BLAST
Formerly type OW
for medium rock
(Limestone, sandstone,
sandy shales)



Type S
ROTA-BLAST
Formerly type OSC-1G
for soft formations
(Calcite, shale, clay)

THIS IS MARION QUALITY Slam the dipper of a mining excavator against a bank and begin to hoist through tons of unshot ore and strange things begin to happen. Cables whip taut, machine pivotal points are thrown under massive stresses and the entire unit is subjected to component-destroying vibration. It takes exceptional designed-in strength to resist such forces over the profit life of an excavator. Marion gives it to you. In almost 2" of solid, high-strength alloy deck plate for upper machinery support, in the 9-yard Type 181-M, for example. In machinery supporting members that are welded integral with the deck for absolute rigidity. In heat-treatment of the *entire* frame to relieve invisible weld stresses. In careful placement of components to spread operating stresses over a large area for additional stability. The long way around? Perhaps. But the safest—for machine and operator. Marion Power Shovel Company, Marion, Ohio. A Division of Universal Marion Corporation.

MARION



Crush more tons per dollar . . .

BUY REPLACEMENT PARTS FROM THE COMPANY THAT BUILT YOUR CRUSHER

You buy a crusher because of the engineering experience the manufacturer has put into it to give you more production for your money. In the same way, the manufacturer of your crusher buys the experience and engineering abilities of the company which supplies certain components and replacement parts for it. The manufacturer profits only when *you* are satisfied with the performance of his product. That's why most big-name crushing equipment manufacturers work closely with AMSCO to give you replacement parts that fit perfectly, assure original equipment performance, and last a long time in the toughest conditions.

When it comes to wear parts, here's why most manufacturers insist on AMSCO. As long-experienced specialists in wear-resistant metals, AMSCO *engineers* alloys to exact formula needed to stand up under the abrasion-impact-pressure crushing conditions of your job. AMSCO cast parts are structurally perfect and contain the proper alloys for longest possible life.

AMSCO parts are patterned from manufacturer's drawings. They are built for *your* crusher . . . not copied from inaccurate field measurements. When you need mantles, concaves, jaws, rolls, plates or liners, get them from the manufacturer who built your crusher. He depends on AMSCO's experienced way with wear-resistant alloys to *help you crush more tons per dollar.*

They're backed by experience...

AMSCO

AMERICAN MANGANESE STEEL DIVISION
CHICAGO HEIGHTS, ILLINOIS

AMERICAN

Brake Shoe

COMPANY

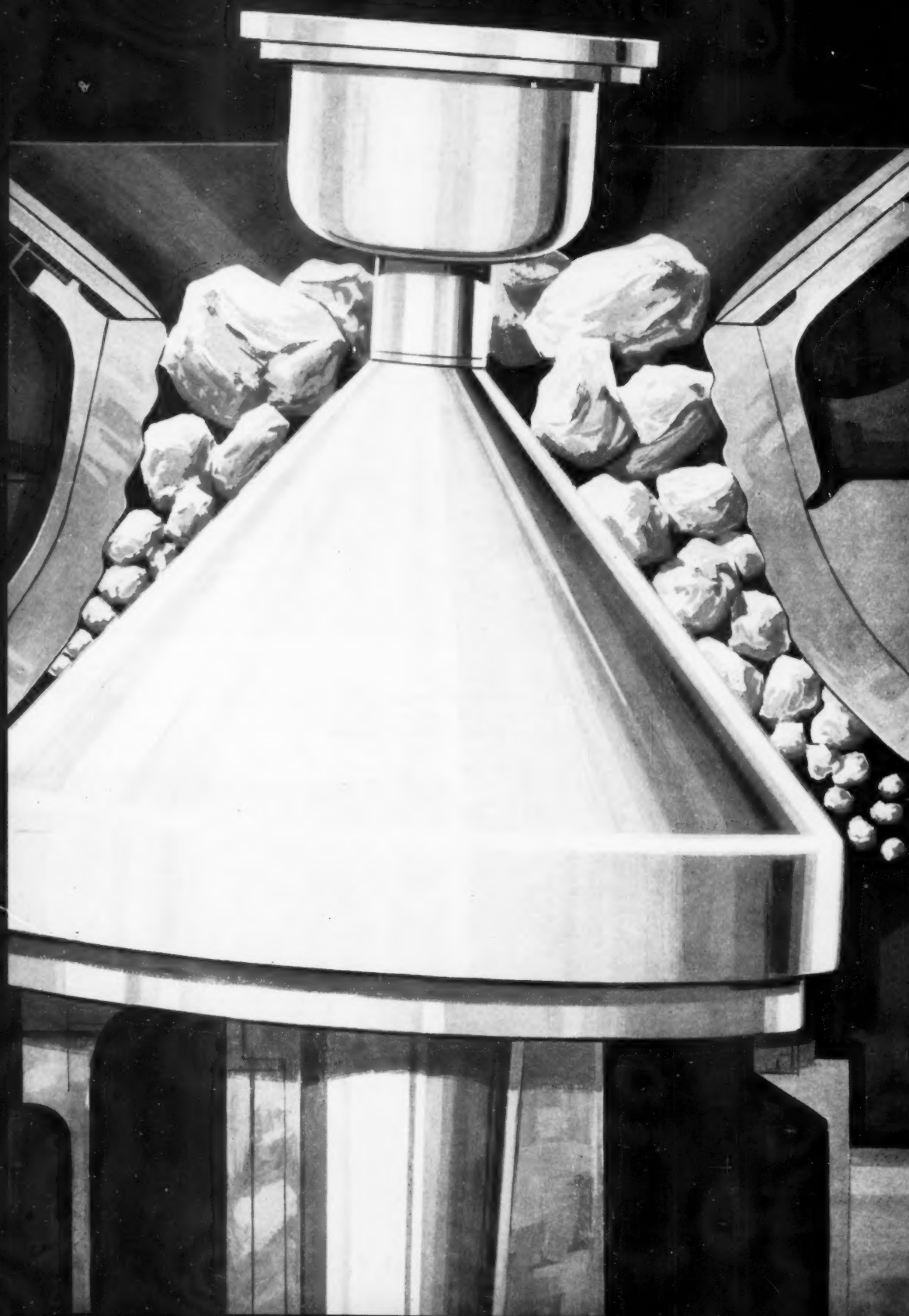
Other Plants in:

Denver • Los Angeles • New Castle, Del. • Oakland, California • St. Louis

IN CANADA: Joliette Steel and Manitoba Steel Foundry Divisions

IN MEXICO: Amaco Mexicana, S. A.

... For more details, circle No. 19 on Reader Service Postcard



Take 15 minutes on a

Prove New International TD-15 cost-cutting capacity tops the 100 hp class

Advantages in heavy-duty hp and in working speeds give the new TD-15 extra work capacity to cut costs, boost earnings — as compared to competitive rigs. *You can prove it, positively.* Advances in strength, wear-resistance, temperature control, and operating ease mean big gains in component life,

upkeep economy and machine availability to owners of new International TD-15's. *You can prove it, beyond doubt, without risk.* Let your International Construction Equipment Distributor give you the revealing 15-minute new "15" demonstration, now!

Prove new TD-15 capacity dozing heavy materials

Fast, easy new TD-15 shifting saves effort, increases output. Size up the new "15's" six-speed, full-reverse transmission with speeds spaced to use extra power and often work a speed faster than competitive rigs. See how the six speeds forward, six reverse, are arranged for easy short-travel, single-stick shifting. Change forward-reverse direction fast with the "Shuttle-Bar." Check the power-transfer efficiency and operating ease of the new "15's" heat-defying, dry-type sintered metal engine clutch!

Give the new "15" a steady job of bulldozing solid materials! Advances like tapered, anti-friction bearings of greatly increased capacity — heavier shafts and deeper, stronger gear teeth — add thousands of hours to transmission component life. New transmission oil pump circulates and filters lubricant for longer gear life. Measure the added economy of features like the new sintered metal steering clutch discs which outlast previous type even while handling greater torque loads!



***International
Construction
Equipment***

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Ill.
A COMPLETE POWER PACKAGE



New "15" (151 SERIES)



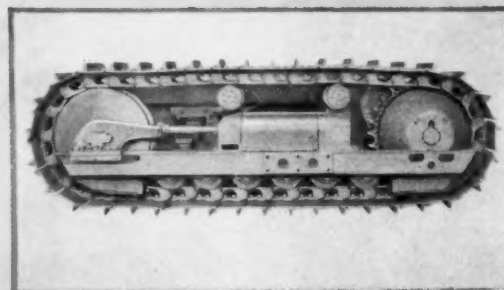
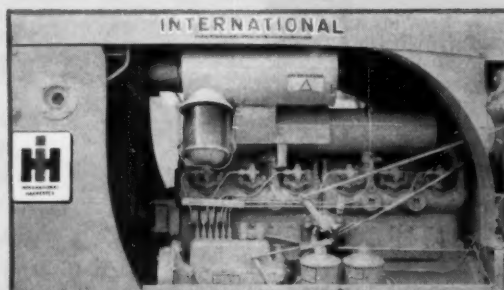
Compare hp and performance protection!

Start the new TD-15's 6-cylinder engine push-button easy — and get the seconds-fast warm-up which only International's famous gasoline-conversion starting provides. Note that full load for the new "15" is an overload for other rigs of the 100-hp class. See how the new pressure-type cooling teams with the larger capacity radiator — to give positive temperature control in hottest weather at full capacity 'round the clock.

Look at the "15's" new dry-type air cleaner. It's 99.8% efficient — and 100% convenient! Handy, underhood mounting and transparent, quick-dump collector greatly simplify servicing. International even provides a dash indicator that shows red when element needs servicing!

Prove new "15's" undercarriage strength!

To go along with precision-welded double-box-beam TD-15 track frames is the added strength of drum-type front idlers — the added protection of frame-welded track chain guides — the added service life of self-cleaning, power-saving strutless track links. The new "15" is the only crawler of its power class with the shock-load prevention of ball-joint suspension — basic in International's famous 3-point track mounting design! Improved, high-efficiency full-floating seals protect the long life Dura-Rollers — the track rollers you grease only once per hundred 10-hr. shifts!



**MORE
EXPLOSIVE
NEWS FROM
DU PONT**



**Which of these HDP Primers
will best meet your conditions?**

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New Du Pont HDP Primers are High Detonation Pressure units especially created for priming such materials in holes from 2" diameter on up.

You have a complete line: HDP-1 weighing one pound and HDP-2 weighing half a pound are for holes 4" in diameter or larger. HDP-3 is one-third pound, and is for use in smaller holes, down to 2" diameter. All three contain a high-density explosive, which develops a velocity of almost 5 miles per second and a temperature of about 7500° F. This combination gives the very high detonation pressure needed to develop full energy from non-cap-sensitive products.

EASY ASSEMBLY

There's no nitroglycerine in HDP Primers, so they are less sensitive to shock and friction than dynamite primers. There's no headache-causing ingredient. And assembly to "Primacord" or caps is easy to make, through holes in each primer. You can even do it with heavy work gloves on.

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Your Du Pont Explosives Department representative or distributor can arrange for you to try out new HDP Primers now. Call him for details. Or for a copy of our new bulletin on the subject, write Du Pont, 2446 Nemours Building, Wilmington 98, Delaware.

EXPLOSIVES



Better Things for Better Living . . . Through Chemistry



Bunker Hill Forms Group To Develop California Iron Ore—

The Bunker Hill Company and associates have formed a new company—Iron Exploration Company—to prospect, develop, mine, beneficiate, and ship to off shore markets iron concentrate from Shasta County, California. The new company has a geological staff and two diamond drills at work on claims on the McCloud River near Lake Shasta north of Redding.

The exploration program is designed to develop ore (magnetite) in a contact metamorphic zone between limestone and diorite which can be mined by open pitting and concentrated by magnetic separation to yield a marketable product. While about 300,000 tons of ore has been mined from the deposits in the last 50 years for local use in an electric furnace, for ship ballast, and for blast furnace feed an extensive exploration pro-

gram is necessary to develop enough tonnage to warrant large scale operations. Known reserves, several 10's of millions of tons, require upgrading which will yield a plus-60-percent iron concentrate while eliminating the sulphur in the crude ore.

Bunker Hill is scheduled to administer the program and has included as associates Morrison-Knudsen Company for open pit mining and coarse crushing, W. R. Grace and Company for marketing, and Hydrocarbon Research, Inc. because of its knowledge and interest in a direct reduction process.

While final determination to place the

mine in operation and build a mill must await further drilling results consideration is being made to build about a 2,000 ton per day dry magnetic-wet grinding-wet magnetic concentration mill near the mine. Concentrates probably will be barged across the lake for loading on railroad cars. Metallurgical testing of split cores is being done to determine the best mill flowsheet.

Harold E. Lee, Bunker Hill's vice president in charge of research and development, heads the project assisted by R. J. McRae, manager of outside exploration; J. A. Harker and Allan Thompson represent Morrison-Knudsen.

Exploratory Drilling Already Underway

Alcoa To Build \$100,000,000 Aluminum Complex in Australia

Aluminum Company of America has announced its newest overseas venture. It will establish a new company, Alcoa of Australia Proprietary Ltd., to build and operate a \$100,000,000 integrated aluminum complex in southern Australia. The new concern, to be owned 51 percent by Alcoa and 49 percent by a group of leading Australian mining companies, plans to begin construction by the end of this year, and to commence

operations within 24 months.

When completed the project will include (1) bauxite mining facilities for deposits near Perth on Australia's west coast; (2) a refining plant in the same area for production of alumina; (3) transport of the alumina 1,700 miles by sea to Geelong on Australia's southeast coast; (4) aluminum production at Geelong in a smelter with an annual capacity of 40,000 long tons; (5) fabricating fa-

cilities at a new plant at Geelong for aluminum alloy sheet, foil, shapes, tubular, and other mill products; and (6) power production to supply the requirements of the smelting and fabricating operations, by a new steam generating plant at Geelong.

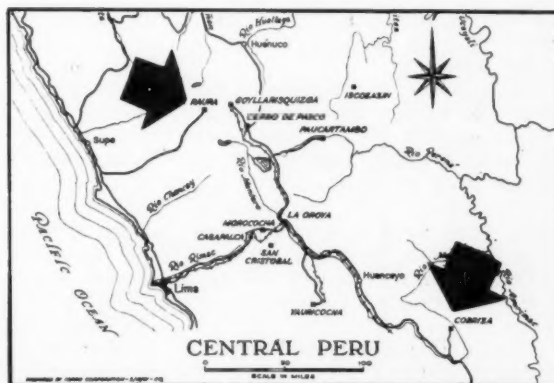
Australian interests represented in Alcoa of Australia include Western Mining Corporation Ltd., North Broken Hill, Ltd., and Broken Hill South Ltd.

Cerro de Pasco Will Develop Two New Base Metal Mines in Peru

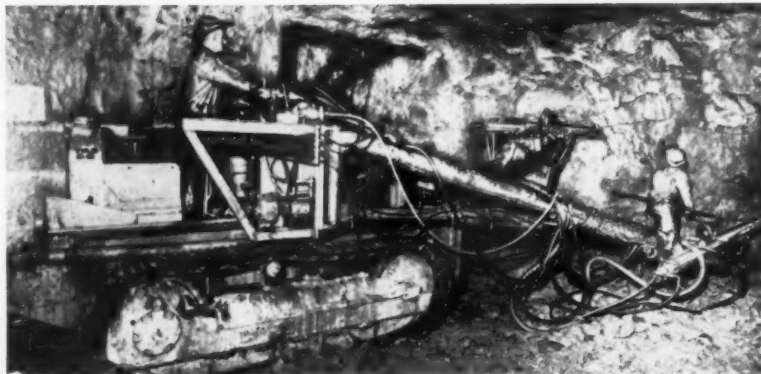
Two new mines, at far separated localities, are being developed for early production by Cerro de Pasco. See adjoining map for locations.

Cerro has had an interest in the Raura copper-lead-zinc-silver ore body since 1945 and will now build a 120-ton-per-day differential flotation mill at the mine. A new company—Compania Minera Raura, S. A.—60 percent owned by Cerro and 40 percent by Sociedad Minera Puquio Cocha—will be the operator. Concentrate will be trucked to Supe and exported.

The Cobriza copper deposit has been under development since 1956 with favorable results so that Cerro purchased the property in early 1961. Ore reserves developed to date contain several percent copper and the chance for additional tonnage is good. Engineering studies are now being made to determine optimum scale of operations—from 500 to 1,000 tons per day. Copper concentrate will be trucked to Cerro's La Oroya copper smelter.



HEADFRAME at No. 27 with service crane (arrow). Trucks with mine equipment drive under beam and crane picks up load and puts it right on mine cage.



TRI-BOOM JUMBO mounts three Gardner-Denver SF79B drifters with 12-foot automatic screw feeds. Jumbo mobility is by Caterpillar D4 Traxcavator mounting.



LOADING HAULAGE team is the electric powered St. Joe shovel and 10 ton Cline Diesel truck. Two trucks and one shovel have loaded and hauled 580 tons per shift.

Why St. Joe's Viburnum Is Today's

Viburnum No. 27 mine of the St. Joseph Lead Company—the "Underground Mine of 1960"—has now reached an average production of 2,260 tons of ore per day. Total crew is only 47 men, exclusive of supervisors. No. 27 is the first of three mines planned for the "New Lead Belt" 40 miles southwest of Bonne Terre, Missouri.

The discovery and outlining of the New Lead Belt are the result of years of geological study and drilling of thousands of wildcat holes over many square miles of Missouri. The Viburnum discovery hole was drilled in 1955. There were no surface indications or surface geological clues to indicate mineralization; all the surface rock consisted of post-ore sediments.

The St. Joseph geological department has published several papers on

the occurrence of the several types of ore bodies being mined, so only a brief summary will be included here.

At Viburnum the ore is found in the Upper Bonne Terre (upper Cambrian) dolomitic limestone. Ore in this upper section is thick and high-grade in contrast to that found in many places in Missouri in the lower part of the formation.

No. 27 is one of three mines planned for Viburnum, and was the first mine placed in production. It is in the extreme southeastern part of Crawford County, 4.4 miles northwest of the mill which is also the location of the No. 28 mine. This is in the northwestern part of Iron County. The mill site was selected at a point as close to the center of the ore bodies as possible. That is the point where the minimum number of ton miles of transportation would be

necessary to transport the total ore to the mill. The No. 28 mine ore is dumped directly into the primary mill bin. This mine is identical in planning and layout with No. 27, except that Transloaders will be used for loading and transportation.

No. 29 mine will be the third mine developed and is to be similar to the other two. It is 4.6 miles northeast of the mill and is scheduled to be brought into production in the future.

The three mines are in an area where St. Joe controls or leases several thousand acres of land. A good deal of this is National Forest land where mining rights are leased from the United States government. Thus, each mine produces both St. Joe and government ore. The different ores are mined, hoisted, crushed, weighed and sampled separately before being



MAINTENANCE is key to mechanized mining and St. Joe has always laid great stress on its underground shops where re-

pairs can be quickly made on equipment. This well lighted shop with bridge crane and repair pit speeds truck servicing.

Most Important Underground Lead Mine

combined for the first time in the fine ore bins. Royalty payments are accurately calculated from data supplied by this system.

Production of 2,260 tons per day by the 47-man crew is the best indication of the efficiency of the mine. It is even more impressive because 80 percent of this tonnage is mined from development headings. No large-scale stoping, mining of back, or pillar slabbing has been started in this new and rapidly developing mine.

The Viburnum mines and mill are part of St. Joe's Southeast Missouri Mining and Milling Division, Elmer A. Jones, division manager; L. W. Casteel, assistant division manager; and Kenneth Baker, Viburnum superintendent.

Here is the job allocation for the crew, headed by mine captain Earl Holley, shift foreman Paul L. Yount

and Raymond Thompson, and maintenance foreman Earl Wengler. The crew: 13 machine men, six shovel operators, six truck drivers, six mechanics, two road grader operators, three hoist men, two skip loaders, one change room attendant, four shift extra men, and four development drillers.

Now let's take a look at what equipment the crew uses and how they do their jobs, so that we can study and evaluate why Viburnum's the most important new lead mine in the United States today.

Mining is on a two shift per day basis, with some hoisting from the 5,000-ton skip pockets on a third shift.

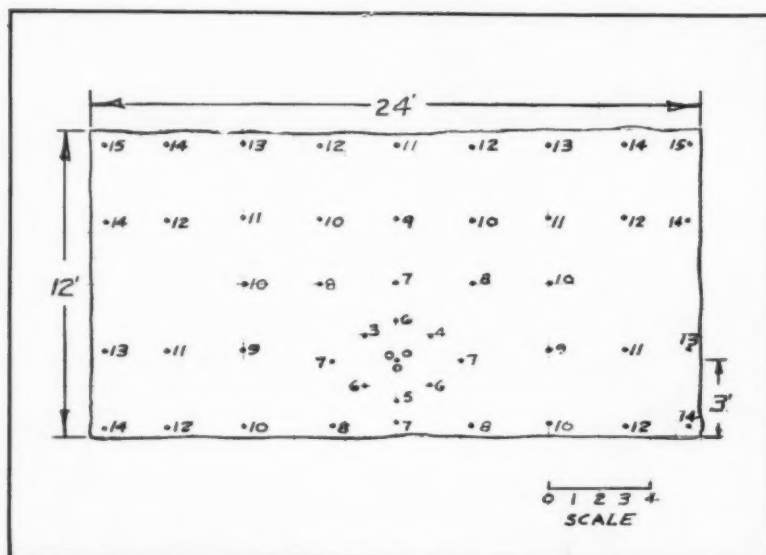
Mine development is on two levels 75 feet apart vertically with the bottom level 804 feet below the surface. Two drill crews of two men each are

the main drift development crews; they drive drifts well ahead of mining to reach drill holes and open the mine for controlled drainage. A Sanford Day Transloader is used for mucking and haulage to shaft pockets from these headings.

Thirteen drillers are assigned to production and they use three Gardner-Denver tri-boom jumbos mounted on Caterpillar D4 Traxcavators and one Airleg drill. Broken ore is loaded by three St. Joe shovels into six 10-ton Cline Diesel trucks. The six shovel operators and six truck drivers form three production teams on each of the two shifts. One shovel alternately loads two trucks. The driver alternates between the trucks so that the shovel loads an empty while he drives the loaded one to the shaft pocket. One spare shovel and three spare trucks are available to be ro-



BURN CUT shows plainly in this picture taken as miner loads dynamite.



HOLE PATTERN for shatter cut drilled low in 12 by 24 foot development drift at Viburnum. The number indicates the delay number for adjacent hole.

tated with operating units for maintenance and lubrication. The mine crew also includes two motorgrader operators, one per shift; four shift extra men assigned by the foreman to fill vacancies or do special work; and two skip loaders.

The haul roads are kept graded at all times so that hauling speeds of 15 miles per hour are easily maintained. As needed, crushed and sized rock is used to build a permanent road. Main haulages are driven 12 feet high and 24 feet wide so that trucks can pass at any spot. A Pittman "giraffe" is used to reach and easily scale high backs.

St. Joe has developed an effective burn cut round for drifting. The hole spacing and delay sequence for a development round in the standard 12 by 24 foot heading is shown. This is called a delay pattern shatter cut (drilled low). The latter refers to the position of the burn cut. While experience has shown that this cut can be drilled anywhere in the round with the rest of the holes spaced accordingly, the low drilling (positioning) feature is of paramount interest to the drill crew. This is because the three relief holes (each three inches in diameter), the center blasted hole, and the eight relief holes around the cut (all 1½ inch in diameter) are drilled by the center machine on the jumbo. This machine is operated by one man who stands on the ground to be right at the face to accurately space and align these important holes.

"Drilling low" facilitates his close supervision. One man on the jumbo operates the other two (outside) hydraulically controlled machines to drill out the rest of the round. The Gardner-Denver jumbo mounts three SF79B drifters with a remote controlled drill positioner, and a 12-foot automatic aluminum screw feed to drill a 12 foot deep round. Gardner-Denver's carburized 1-inch quarter octagon drill steel 13 feet long with an extra-long (6-inch) shank is used. Steel is collared. TC Liddicoat slip-on carbide insert bits 1½ inch in diameter are used to destruction; 500 to 600 feet of hole.

Burn cut for any round

By using the burn cut, it is easily possible to drill any size round up to 20 feet high and 35 feet wide with the jumbo. Of course it requires more holes to break the larger faces and these are generally added on 3 by 3 foot increments. This optimum spacing naturally varies with any important change in the ground.

The 35 foot maximum width which can be drilled with the jumbo was selected as the minimum effective width in which the Cline trucks could turn around without backing, and as the space necessary to turn the jumbo at right angles to start the crosscut.

The three-inch burn holes are drilled with Joy J-40-3 tungsten carbide bits screwed on the end of special drill rods.

Contrary to normal blasting practice, the cut holes around the burn are loaded with only 20 percent powder, Hercomite 7A. The rest of the round is loaded with 60 percent Gelamite No. 1. To speed loading, sticks are all 1 by 24 inches. P-83 Hercules electric blasting caps are used for firing. They are more accurate and afford longer intervals than normal millisecond caps. The mine is still wet, with water running from many holes, so that gelatin dynamite must be used.

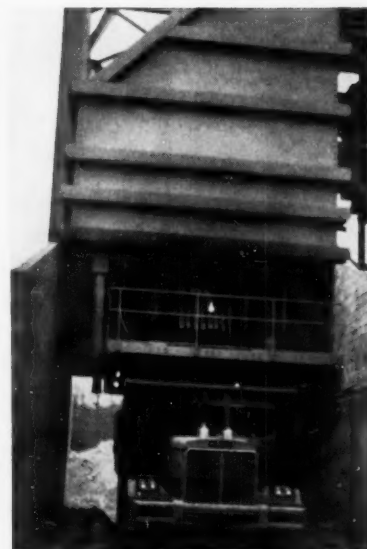
Drilling and breaking, the most expansive mining operations, have thus been mechanized and standardized for low cost and high output per man shift. The average round breaks 400 to 500 tons. It breaks cleanly with minimum throw, so mucking can be started sooner. The special burn cut is the key to successful breaking and was developed by the Mine Research Department of St. Joe after several years of experimentation and testing of more than 30 burn hole patterns.

The time-tested electric powered St. Joe shovel is used for loading most of the ore at No. 27. This unit has loaded as much as 580 tons in one shift, but averages about 375 tons. Trucks are Diesel-powered and are equipped with St. Joe water-filled exhaust gas scrubbers. Two of these trucks can keep a shovel loading to capacity with haulage distances up to 4,000 feet.

In an effort to cut both loading



TRANSLOADER is used for mucking out the development headings at No. 27 mine. At No. 28 mine (at the central mill) it is being used for development and production.



LOADING 30-ton Cline Diesel truck at No. 27 ore bin for haul to central mill.

and hauling costs, the Transloader is being used at No. 27 on the upper level development, and at No. 28 for both development and production.

Grouting minimizes water

No system of systematic ground support has been needed to date. Water inflows, however, have been a problem and while not unexpected, as the mine pumping plant was designed with two 500 gallon per minute pumps, development soon cut a number of water-filled vertical fractures and major water-bearing fissures, so that the pumping load soon reached 4,000 gallons per minute, and then receded to 3,000. Four Peerless 1,050 gallon per minute deep well pumps are used to keep the mine dewatered.

It has been necessary to long hole ahead of several development headings and seal water-bearing fissures with cement grout. The No. 27 shaft bottoms in Pre-Cambrian rhyolite porphyry and the sump, shop, and skip loading pocket are all in the porphyry which is relatively dry. However, the shaft station and skip pocket at the No. 28 mine had to be cut in water-bearing sandstone and AM-9 chemical grout was used to form an impervious fence around the shaft. See November 1960 issue of *MINING WORLD*, pages 33, 34, and 35, for a report on this grouting, "How Research Advances Grouting Techniques at St. Joseph Lead."

Each mine has an auxiliary shaft

for ventilation and man escapeway. These shafts (52-inch diameter holes, steel cased to 46 inches) were drilled from the surface using a three-ring multiple plate bit mounting 14 roller cone bits. The No. 27 ventilation shaft was sited in a draw south of the main shaft to reduce depth to only 600 feet. Actually, core was first cut in the No. 27 shaft, but this method was soon abandoned in favor of the non-coring bit. Fifty thousand cubic feet of air per minute are pulled down this shaft and blown into the mine workings by an Aerodyne fan mounted at the bottom.

All mines will have standard 12 foot 7 inch diameter concrete lined circular shafts. Shaft sinking at No. 27 started in March of 1958, and was completed eight months later.

St. Joe circle at stations

The special St. Joe dump circle station is used on both levels, where the incoming trucks move counterclockwise to reach the grizzly dumps. After dumping, the trucks continue the circle back to the outbound or right stub of the drift they entered through. The dump circle is a 12 by 18 foot drift driven on a 57-foot radius. The standard four direction development has four main headings driven from the circle, but each heading has two curved entries leading from the circle so as to minimize the curve necessary to change direction at almost a right angle.

On the main level of No. 27 shaft,

there is a complete underground repair shop for shovels and trucks equipped with a grease pit, tire repair bay, electric shop, and small warehouse.

Ore is hoisted in an eight-ton St. Joe bottom dump skip slung under the nine-man capacity cage. Steel rails are used for guides. Twelve rubber tires in groups of three—two groups at top and bottom—hold the cage-skip in line on the guides. Four wheels hold the skip between the guides, and four on each side of the rail prevent swinging in the shaft.

Thirty-ton capacity Cline Diesel trucks haul ore to mill bin over the company built and maintained road. Uncrushed mine waste was used as a base when the roads were built. The three foot thick base is covered with six inches of compacted gravel. The gravel is sealed with an oil coat which also makes a dust-free surface. Maximum grade is 4.6 percent; width is 35 feet for high speed hauling.

Viburnum will be producing lead for a long time. The ore is high grade—3.0 percent lead, less than 1.0 percent zinc and copper—by Missouri standards. Ore bodies are thick and fairly continuous, and mining costs which are already low by all standards will be lower when the mine is fully developed and large scale stoping of the high ore is started.

Viburnum will be the underground lead mine for many years, not for 1960 alone.

END



UNDERCUTTING is first step in driving through massive potash salt beds to develop drifts and cross cuts.



DRILLING blast holes with twin boom hydraulically positioned jumbo. All machines are electrically powered.

Montecatini Mines Steeply Dipping

by Pierluigi Salle

The new San Cataldo potash mine of the Montecatini Co. in Sicily is the world's newest potash producer. It is unique in that steeply dipping 60° beds up to 95 feet in thickness are being mined. While there is some undulating and rolling of the potash beds in the United States and Canada, they are essentially horizontal and under 20 feet in thickness. Thus this new mine is unique in several respects.

The mining plan is such that carefully spaced pillars are left to support the overlying strata while permitting a high extraction of ore.

There have long been indications of potash in Sicily from sulphur exploration, but it wasn't until 1952 that a detailed exploration program was started by the company seeking commercial deposits of potash.

By geological mapping and detailed prospecting an area was considered favorable for buried deposits. This is a 40 kilometer wide strip extending from the western slopes of Mt. Etna to the Mediterranean Sea coast near Sciacca. The syncline strikes northeast with the salt mass forming a kind of amphitheater. Along the two flanks of the anticline, on the footwall of the salt, two sulphur ore bodies have long been known and mined respectively by the Stincone and Bosco mines.

Mr. Salle, a mining engineer, is a member of the Central Mining Staff of the Montecatini Company.

The potash-bearing formation in which the San Cataldo mine was developed, sandwiched within a rock salt layer more than 200 meters thick, consists of several stratas of kainite ($\text{MgSO}_4 \cdot \text{KCl} \cdot 3\text{H}_2\text{O}$), carnallite ($\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$), and sylvite (KCl). The dip is about 60°; thicknesses are somewhat variable and so are the ore grades. The mineable potash ore bodies total about 50,000,000 tons.

How mine developed

The mine is developed by footwall drives at a vertical distance of 66 meters from each other. Every 100 meters along these drives crosscuts are driven. At each crosscut a raise is driven to provide access to working places and ore chutes. It follows that the mine is thus being divided into blocks 66 meters high and 100 meters long.

One stope involves two adjoining blocks (i.e., a length of 200 meters) with a central crosscut, in common, at the bottom of the block which is used for hauling of ore, ventilation, and general services. Air flow, after ventilating the stopes, passes through the raises and the lateral crosscuts of the two blocks into the upper level footwall drift.

The mine operates two 8-hour shifts per day. The output of 3,000 tons-per-day is presently stoped from the two kainite beds. The first is 4 meters (about 13 feet) thick and has a grade of 17 percent K_2O ; the second is 30 meters (about 97 feet)

thick, assaying 13 percent K_2O . Each bed is mined in one stope only, with a production of 500 and 2,500 tons per day respectively. These stopes are at present in the upper portion of the mine, between the "plus-142" and "plus-76" levels. (See mine diagram No. 1.)

The two beds have the same dip and strike, and therefore can be mined simultaneously in each block, utilizing the same development.

The Montecatini Co. concentrated its exploration on the central part of this strip. After an intensive drilling campaign, two interesting areas containing potash ore bodies were localized and they were also chosen as the raw material on which to base an important industrial activity. The first of these areas is located about 4.0 kilometers north of Serradifalco, the second 5.0 kilometers northeast of Rocalmuto.

In the first area the San Cataldo mine has been developed, and already has achieved a production of 3,000 tons per day of potash ore. Other shafts are presently being sunk in the area for another mine with the same potential output.

In the second area (Rocalmuto Basin) important exploration work is in an advanced stage. With a considerable tonnage of potash ore already developed, other high capacity mines are being planned.

The mine is developed in a salt lense included in a Miocene syncline of the so called "gypsum-sulphur bearing" series. However, the stoping



LOADING broken ore into shuttle cars. The mining and haulage units were all built in the United States by Joy.



CONVEYOR BELT haulage is used to transport all ore to crusher station on bottom level from ore pass raises.

Potash Beds By Sub-Level Stopping

methods are different for the two beds because of their different thicknesses.

In the 4-meter bed, sublevel stopping along strike is used. The mining faces are not kept on the same vertical line, but form a reverse steplike form (Figure No. 2). The broken ore falls down to the base level drive; it is then dragged by rope scrapers to the ore chute. Two adjoining blocks are mined simultaneously and symmetrically, retreating toward the central and common raise.

The main output of the mine comes from the 30-meter bed (97 feet), where stopping is performed in such a way as to allow maximum intensity of production and efficiency by complete mechanization.

Why the corkscrew incline

The stope preparation, in the two blocks, is as follows: the lowermost and the uppermost central crosscuts of the blocks are connected by means of a corkscrew drive which winds upward at a constant slope of 12° inside the mineable ore stratum. The drive, which is the main peculiarity of the planned stopping method, fulfills the following requirements:

1. It provides a central, high-clearance, passageway connecting all the working slices.
2. The corkscrew with its limited slope can be excavated by the very same machinery later used in the stopes, and with about the same production per shift.
3. The excavation is completely de-

veloped in the ore and therefore requires no extra cost.

Sublevel crosscuts are established at vertical intervals of 8 meters and are connected to a previously driven raise. This system (sublevel drifts plus raises) decreases the lengths of blind ends as well as the haulage distances during the driving of the inclined corkscrew. These crosscuts are then used for conveying the ore coming from the stopes.

As soon as the inclined drive is completed, stopping preparations start at vertical intervals of 8 meters by driving, along the footwall of the ore bed, two opposing 100-meter-long drifts to the end of the blocks where ventilation raises are opened.

The sublevel drives are 6 meters wide and 4 high. Once these workings are completed, stopping takes place retreating from the ends of the drives by excavating chambers (rooms) 12 meters wide and 4 high, leaving pillars between them (See Figure Nos. 3 and 4). The pillars are not recovered.

On the different sublevels, the chambers are excavated one above the other, leaving a 4-meter thick floor pillar between them, which is then recovered during retreating. Stopes thus are rooms 12 meters wide between vertical pillars which insure stability in the ore mass. The stability of the ore deposit is also assured by horizontal floors left at convenient vertical distances. Both development and stopping are carried out by Joy electric-powered self-mov-

ing machines including under-cutters, loaders, jumbos and shuttle-cars.

Underground belt haulage

The mine is served by a main shaft connecting the surface (367 meters above sea level) with the bottom level ("plus-10"). Ore is hoisted in skips by an automatic Koepe wheel. Hoisting capacity is 300 tons per hour.

At the bottom of the hoisting shaft there is an underground crushing plant, with two ore bins (total capacity: 800 tons) and two screening and crushing sections (each one with a capacity of over 300 tons per hour).

All ore coming from the stopes is transported by belt conveyors to this plant. A separate inclined conveyor belt raises crushed ore to the skip loading installations.

Ore transport from the crosscut underlying the ore chutes to the main drift is by belt conveyors, so that all haulage and hoisting from the stopes to surface is automatically performed.

Air enters through the hoisting shaft and is conveyed to the drives and crosscuts of the "plus-10" levels. From there it passes directly to the stopes, rises through the corkscrew drive and is then split into two separate currents, each of which passes through one of the two blocks. Air then reaches the main ventilation drift at the "plus-142" level, after having passed through the two highest crosscuts. From the "plus-142"

level the current is drawn out through an air shaft equipped with a 700 horsepower exhaust fan.

Flotation concentration

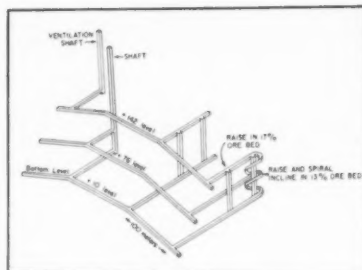
From the shaft collar, the ore is conveyed automatically to the mill; first through two crushing sections, each of which has a capacity of 300 tons per hour.

High grade ore (17 percent K_2O), after being crushed to minus-2 millimeters, is conveyed straight to storage. Low grade ore (13 percent K_2O) is sent to a flotation section

where the grade is increased to 17 percent K_2O .

The flotation plant contains two sections, each with a capacity of 50 tons per hour. Flotation concentrate then joins the high grade ore that needed only crushing to size.

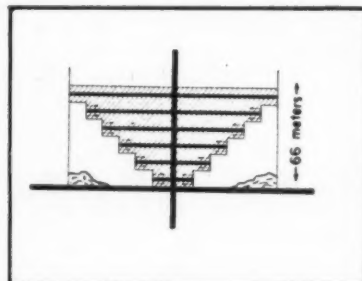
From the storage bins the high grade products are automatically loaded onto an 18-kilometer-long aerial ropeway, having a capacity of 200 tons per hour connecting the St. Cataldo mine with the Campofranco plant for processing and conversion into marketable products. END



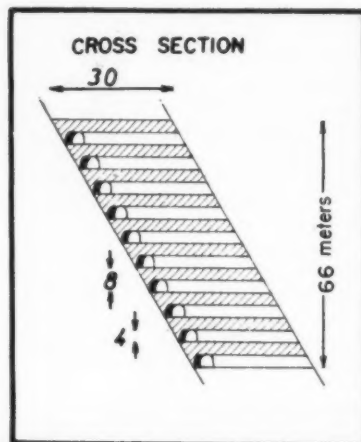
MINE DEVELOPMENT diagram showing major openings and corkscrew raise in thick ore. Shaft top left. **Figure No. 1.**



TWO CREWS OF MINERS use electrically driven augers to drill blast holes in sub level stope. This is the thinner high grade bed.



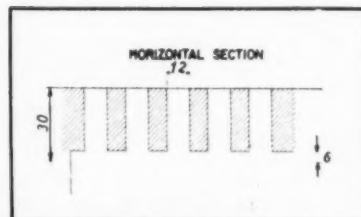
STOPING retreats to center as ore (shaded) benches are blasted. Solid lines are mine openings. **Figure No. 2.**



CROSS SECTION through thick ore stope. Dimensions shown are in meters. True ore dip pictured. **Figure No. 3.**



FLOTATION MILL where the low grade (13 percent K_2O ore) is raised to a 17 percent concentrate. Hoisting shaft at top left.



HORIZONTAL PROJECTION of Figure No. 3 showing plan of one sub-level. This is **Figure No. 4.**

by James V. Thompson and M. B. Falkell

Mr. Thompson is principal engineer, Kaiser Engineers, Oakland, California. Mr. Falkell, who drew the illustrations, is with Kaiser's Public Relations Department.

Why didn't I think of that

We always have trouble starting an article. However, we just finished reading a Civil War book which contained letters from soldiers to the folks back home. One of them started: "Dear Wife, I take pen in hand." Now, that was getting right to the point. So, "Dear Reader, we sit down to our typewriter . . ."

The mineral industry has witnessed many important advances in the past 25 years, but it sometimes appears that many of these developments are the result of perfecting old ideas and employing obvious principles. Manufacturers who have spent hundreds of thousands of dollars developing ideas and equipment will not brook any of our nonsense about how obvious it all was in the first place. But we admit that we are writing from the advantageous position of hindsight, and if we speak facetiously, we are laughing at ourselves, as we have been associated with—and frustrated by—some of the developments we intend to discuss.



To speak with authority on a subject such as this, one must be a qualified "Visitation Engineer". This is a new field, largely developed since World War II. However, the Colorado School of Mines did offer a very concentrated course at the end of the senior year. Most Visitation Engineers around today are, shall we say, self-made and without formal academic training in the field. We predict that in the near future all mining

schools will establish a department of Visitation Engineering. The undergraduate subjects will include such courses as "Visiting the Iron Range", "Attending AIME Conventions", "How to Stay Awake at Technical Sessions", "A Visit to the Porphyry Coppers", and "Fundamentals of Airline and Hotel Reservations". The candidate for the masters degree will be free to study the more complex problems such as "How to Get Cost Data Out of Plant Managers". At the doctorate level we would expect such research papers as "How to Break Even on Expense Accounts" and "Living on Credit Cards".

In time, the various states will require registration. Some prominent VE's will found the American Institute of Visitation Engineers, and a few disgruntled VE's will form the rival American Association of Professional Visitation Engineers. Having established the nature and something of the future of Visitation Engineering, we will go deeper into our subject feeling sure that our readers will understand why, to write a paper like this, one must be a VE.

Necessity is reported to be the mother of invention. The father, to our knowledge, has not been identified. We might speculate that the sire is "frustration". To illustrate the point: When mine timber could be cut by \$4.00-per-day labor and installed by \$5.00-per-day timbermen, there was little incentive to develop anything different. But when timber costs over \$100.00 per thousand board feet and must be placed by \$20.00 (plus fringe)-per-day timbermen (?) who cut posts and caps 6 inches short and fill in the intervening space with wedges, we are creating the right environment for a mating of necessity and frustration. In mine roof support, two such births come to mind: the roof bolt and the adjustable steel mine prop. As obvious as roof bolting appears to be, it seemed to take a long time to come around.

We remember visiting an under-

ground compressor room before the war. Roof bolts almost got invented there. To secure the roof, we were told at the time, long lengths of old stoper steel were drilled into the roof. The stoper was then removed and a special hose fitting was placed over the end of the steel and a fine sand grout was pumped in through the hollow drill steel and the steels were thus cemented in place. Wire mesh was then spread over the roof and



tack-welded to the exposed steels and the whole job was gunited. Here we have an early roof bolt—but not quite—the steels were not in tension.

You would think that the people who thought out this scheme would have gone just one step further. Thread the end of the steel (if they could find a thread cutter tough enough), put on a washer and run a big fat hex nut down tight on the washer. The grout would not have made a good anchor, but all mines have machine men that can stick any steel quite effortlessly.

But more of this "Why didn't I think of that" bit comes to mind with the down-the-hole drill. Not so long ago we were running a small poor-boy exploration effort in southwestern Colorado. We had a 2½ inch

Why didn't I think of that?

continued

machine mounted on a wagon drill rig that would accommodate a 6 foot change of jointed steel. Admittedly, this rig was small and underpowered, but we only needed 50-foot holes. After establishing our camp, our mobile rig was trundled up the hill to the site of the first hole. With all of our roaring 210 cubic feet per minute at 125 pounds per square inch, we put down the first two and a half lengths of steel, where it promptly became stuck and is there to this good day. Now, by explanation, during the big push of the 1950's on the Plateau, the people who sold tungsten carbide bits, bit adapters, jointed steel, couplings and shank adapters, all got it made and by 1957 had retired because a pound of this hardware fetched more than Yellow Cake. We made some remarks to the driller to the effect that the purpose was not to drive this expensive steel into the ground for stakes, but to recover it each time and repeat the process over and over again. The driller, menacingly holding a 36 inch Stillson at batting height, replied that every driller has got to get used to the ground and then added some suggestions as to where we might stow a few lengths of steel if we were displeased with his methods.



With 54 feet of steel and fittings in the hole, this hardware was worth well over \$200. The grim mathematics of this situation was small comfort to the boss of a poor-boy job, but with all that dough in the hole, it had to happen—at least once—and it did. The string broke just above the first coupling, leaving eight lengths in the hole to, forever, be a part of Colorado.

After passing out black arm bands, we knocked off for the day. We pondered on what a lousy way that was to put a hole in the ground. By the time the impact from the hammer was transferred through all that steel and couplings, there was not enough energy released at the bit to drive a thumb tack; and not only that, the hammering of the steel was

what caused it to break. That evening we reasoned that the trouble with that sorry rig was that the drilling machine was on the wrong end. If we could just trim the horns off that monster, slim it down a bit and put the bit on the end of a short shank, then we would screw the steel into the back of the machine; only it would be air pipe and also support the machine in the hole—Forget it—then we would stick machine and all in the hole.

Without doubt, one of the greatest burdens to be lifted from the back of the hard-rock miner was another obvious—and long-awaited discovery—the detachable bit. Before detachable bits, drilling was done with “conventional steel”. The origin of this quaint term is lost in antiquity, and no mention of it is to be found in *De Re Metallica*.

One of the prime requisites of conventional steel was that it be able to stand arduous travel, both horizontal and vertical. Between the time it left the warehouse to be cut, shanked and forged into, say an 8 foot change, until the day it broke the toggles in the jaw crusher, after being discarded in the muck pile as a dull starter, it traveled thousands of miles between the working faces and the mine blacksmith shop.

If there was any true science connected with the forging and tempering of conventional steel, it must be lost and the last mine blacksmith carried its dark secrets to the grave. However, being endowed with all the natural, healthy human laziness, the smiths were quick to accept the air-operated shanking and bit-forging machines. But for the tempering, that had to forever remain the secret of the cult. Donning ceremonial robes, the smith would disappear behind crimson curtains and with a diabolical leer, thrust the hot bit tips into one or more weird fluids, the exact composition of which was known only to him and a few Damascus sword-makers.

As we recall, mine blacksmiths looked upon detachable bit salesmen with somewhat the same regard as witch doctors had for missionaries. But on a ton mile basis, conventional steel had to go. Most mines could run an extra muck train per shift by adapting detachable bits which, by the way, are far more digestible in jaw crushers—however, some problems remain with Symons Cone Crushers.

One of the meanest beasts that was

ever known underground was the “column-mounted drifter”. Some of these monsters would weigh as much as 250 pounds. If this weight was not correct at the beginning of the shift, it sure was by the time the setup was taken down. It took two men to muscle all that iron, and by the end of the shift they were bushed. (Readers will recall that in this by-gone day it was setup, drill out, and blast, or you went down the hill).



Air-operated cylinders have been around mines a long time. They are used to open chute gates, and sometimes you can even close chute gates with them before the drift is full of muck up to the top of the sets. They can be used to dump cars over ore passes, and sometimes they can even be used to fish cars out of ore passes. An air-operated cylinder is a handy tool to have about. But what bedevils us is how long it took for somebody to use an air cylinder to get rid of those miserable columns. Today we all recognize this device as the “Air Leg”.

We recall a more primitive ‘Air Leg’ of sorts. When we were a shifter underground in the Philippines (before becoming a Visitation Engineer), we greatly admired the Filipino miners. We had those column-mounted monsters around, all right, but the Filipinos were too smart to use them. Being small of build, they knew that even if enough of them could get around all that iron, there would not be room enough for all of them in the face of the drift. Their solution was sheer genius. Two of them would get a medium-weight jackhammer, say an S-55, and with a clever arrangement of boards they could drill out a 5 by 7 in half a shift. Of course, you had to watch them, otherwise in a week or so your 5 by 7 was down to a 3 by 3. It was a great relief for a new shifter when he got on to this because then he knew for sure that some malfunction of body chemistry was not making him grow taller.

For a while we ran a manganese mine just north of Blythe, California.

This was under the system where the government paid about twice as much for manganese as it would have cost on the world market. As good as this deal seems to be, it still lacked the perfection that the farmer could have given it. The Farm Block would have been able to set up a system whereby you did not have to mine the manganese, and we must say that this mining was a costly nuisance.

Some of what made this mining so costly was a 325 cubic foot compressor with a Diesel engine drive. This machine we had obtained from Fourthwright P. Moniesworth, the well-known Los Angeles reconditioned machinery magnate. Fourthwright had the most amazing reconditioning shop. It consisted of only simple spray guns and drums of yellow paint.

One mid-afternoon in August, the two-way radio in our pickup truck came to life with the voice of the mine foreman who stated that the 325 had quit, but there was no cause for alarm. We do not want to be in any fires with that mine foreman because of his lack of ability to define "cause for alarm." The trouble, or rather, the disaster, was in the compressor end. Surveying the still smoldering ruins, we noted that (a) the crankshaft was broken; (b) all the bearings and wrist pins were burned out; (c) the cylinders were scored; (d) the valves were gone; and (e) all moving parts seemed welded into one solid mass.

We got Fourthwright on the long-distance phone. After we ran out of swear words, Fourthwright got in a word. He had just the cure, now don't worry. He would have the standard manufacturer's repair kit for that compressor on the plane in the morning.

One day about a week after the boys started to repair the 325, we were sitting in the Blythe office with the 7.5-ton air conditioner turned to high, and about to break out the bourbon and soda, for it was getting well along towards 6:00 p.m. We were thinking of why, aside from Fourthwright's reconditioning, did the 325 fail. Was it because it was reciprocating machinery and therefore damned with inherent weaknesses? Why not a rotary compressor and away with all these complex moving parts. After all, the Corliss steam engine gave way to the turbine; the gas turbine will soon replace the internal combustion engine; so why not a rotary air compressor? How obvious! Tomorrow we will send off a note to all compressor manufacturers telling them to get off

the dime and get rotary compressors invented.

Just then the door opened and in dripped Fourthwright P. Moniesworth. Before we could hit him with the empty bourbon bottle he had us buried under a deluge of brochures describing the new line of rotary compressors he was prepared to offer—but if the price was too steep for us he could provide one of his reconditioned rotary compressors. We have forgotten which Palo Verde tree Fourthwright is buried under.

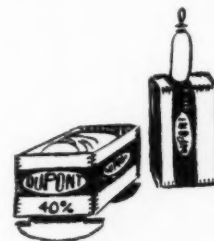
Now to mine ore in most mines you have to break rock. However, there is a great difference of opinion in the industry as to how best to do this. There is a school that says shoot light and do most of the breaking with headache balls, dipper teeth, and crusher parts. The manganese steel producers are believed to favor this method. However, the makers of explosives favor a different approach. Their contention is that it is better to shoot heavy with well-placed shot holes, thereby getting good fragmentation, eliminating headache balls and reducing wear on dipper teeth and crushed parts. We more or less go along with the "well-placed shot hole, good fragmentation school", but what we cannot understand is how long it took to discover explosive fertilizer.



In high school chemistry books of the early 1930's, there was an aerial photo of a large crater about the size of the meteor crater in Arizona. It seems that this crater covered the area once occupied by a German town and an ammonium nitrate plant. We have been told, but have not checked the story, that at this plant there was a large outdoor stockpile of ammonium nitrate. Rains would cause caking and the formation of a crust over the top of the pile. This made it tough for the shovel to load out the railroad cars when orders came in. So Otto, the shovel runner, would tell Hans, the oiler, to put down that oil can and get the hand auger so they could drill a few holes in the pile and shake it up with a little dynamite. But perhaps one day Hans didn't

put the oil can down inside the shovel cab. On that day he took it up onto the pile with him and it tipped over and some of the oil ran down into the auger hole. Parts of the shovel and several freight cars are still in orbit—around Jupiter, that is.

From that day until a shipload of fertilizer removed Texas City, chemists debated the explosive nature of ammonium nitrate. We recall in the technical press the understatement of 1948: "Under some conditions it appears that ammonium nitrate may explode."



Before leaving the subject of explosives, it should be mentioned that it was obvious that paperboard boxes would replace wooden boxes for the packing of dynamite—but it was a dirty trick. How do explosive manufacturers think that a young just-married mining engineer is going to furnish his house without wooden powder boxes? There is many a well-known Visitation Engineer around today whose baby crib had stamped on it "DuPont 40% Straight".

We know something that is obvious and long overdue, and we are going to invent it starting tomorrow. We recall the cog railroad of Pikes Peak, which is a simple use of the rack and pinion to enable a locomotive to climb a mountain. This gives us a great idea. We will rock-bolt sections of rack track to the foot or hanging wall of a raise. (The reader will recall that rock bolts have already been invented). Then, we will build a platform powered with an air motor that drives the pinion that runs on the rack. On the platform the miner can set up his buzzy, throw the air motor into gear and climb the raise. At the top he bolts on a new section and rides on up the back to drill out his round. When he is ready to shoot, he lowers the platform to the drift below, where—now get this—he folds the platform back into the drift out of the way of falling rock when the round is fired.

We never did like climbing raises, and we are going to start on this obvious invention tomorrow—that is, if the Swedes don't beat us to it. Smart people, those Swedes. END



Mining World Photograph

UNITED STATES delegates study the tour schedule boards. Author of this article A. R. Kinkel, Jr., (left) and T. C. Denton.

South African Mining Industry Host To 7th Commonwealth Mining Congress

by **Arthur R. Kinkel, Jr.**
United States Geological Survey

Johannesburg, Union of South Africa—The 7th Commonwealth Mining and Metallurgical Congress in Southern Africa is providing delegates from all over the world an unparalleled opportunity to see how the mining industry is developing natural resources that are probably not equalled in any similar area in the world. With the tour only half completed it is difficult to avoid thinking and writing in superlatives. The vastness of the land and its resources, developed and undeveloped, has undoubtedly been one of the causes of the air of enthusiasm and progress, of friendly but intensive efforts to excel in efficiency and break previous records, that one finds in all phases of the mining industry here.

World records in shaft sinking and drifting require the most detailed planning and programming, and it is not surprising that the staffs who achieved these records could, with much help from the ladies, arrange the excellent program for the Congress. Nevertheless, all delegates are certainly as much impressed with the efficiency and convenience of the travel arrangements as they are with the technical facts of the tours. We are equally impressed with the great hospitality and friendliness which all South Africans are extending to us, and which will certainly be one of our most pleasant memories of our visit.

Canada has provided much the largest number of delegates from outside Africa, but many delegates are here from Australia and England, and many other countries are represented. Fewer delegates came from the United States than had originally indicated they would come.

United States delegates are Mr. and Mrs. Richard S. Newlin of New York, New York. Mr. Newlin is vice president in charge of operations for

the Anaconda Company. Furman H. Burge, United States Steel Corporation, Pittsburgh, Pennsylvania; D. A. Lewis, Sonora, California; T. N. Walthier, Bear Creek Mining Company (Kennecott), Tucson, Arizona; Dr. G. F. Joklik, Kennecott Copper Corporation, New York, New York; B. W. Carr, Ensign-Bickford Company, Simsbury, Connecticut; T. C. Denton, U. S. Bureau of Mines, Washington, D. C.; and the writer.

Mr. William Keyes, U. S. Regional Minerals Officer, United States Consulate, attended the Johannesburg sessions.

The Congress opened April 11 in Johannesburg with a week of technical sessions and visits to the gold mines on the Rand. The problems of high water pressure in some mines, and problems of ultra-deep mining which has reached a depth of 11,246 feet, and is planned to 12,500 feet, were the principal topics of discussion. Pre-development grouting under high pressure is common practice where water flow is a problem, but some of the mines are surprisingly dry. Much interest was shown by delegates in the practice of using prefabricated steel forms to pour concrete in stations during shaft sinking. These forms are standard for all stations; they are sectional, and are first set up and bolted together and then disassembled on surface by the same crew that will install them in the shaft. This allows rapid installation and minimum interference in establishing stations during high-speed shaft sinking.

Much exploration is being done in the areas between the productive parts of the East Rand, Central Rand and Far West Rand, and between the latter and the new developments of the Wetwatersrand in the Orange Free State to the south. A new geologic map of the Rand basin, pre-

pared by Dr. R. Borchers, will be of much assistance in future exploration.

The gold mines of the Orange Free State were discovered in 1939 after years of prospecting and geologic study to find the southern extension of the western part of the Wetwatersrand conglomerates. They are in an area where these are deeply buried by younger barren volcanics of the Ventersdorp System. Since 1939 over 375 miles of diamond drill holes have outlined the geology and productive horizons. Production began in 1949. The establishment of 12 large mines, with the necessary transport, mine communities, water supply and other facilities, including the modern city of Welkom in the center of a sparsely populated farming area, is an amazing achievement in planning and coordination. Gold production from this area, which contains some of the richest gold deposits in the world, reached 6,400,000 ounces in 1960, together with considerable uranium production.

Delegates were next taken by bus and train through the beautiful mountainous areas of Natal to visit the operation of the Umgababa Minerals, Ltd., where high-level dune sands along the Indian Ocean coast are being mined. Ilmenite, rutile, and zircon are recovered by Humphreys spirals followed by magnetic and electrostatic separation, and also on tables. Reserves are large and many similar deposits are known along the coast to the south.

Following the Orange Free State and Natal tours, delegates visited the DeBeers Consolidated Mines at Kimberley. Here mining methods have been radically changed in recent years from the chambering system of stoping to block caving. The change-over is completed in some mines, and by 1962 all mines will be on block

caving. Efficiency has been improved and costs reduced at least 20 percent.

Over 90 percent of the production at Kimberley is industrial diamonds. Daily production is 2,800 carats from 13,000 tons of ore, a reduction of approximately 20,000,000 to 1.

Delegates on this tour also visited the Koeegas mine of the Cape Blue Mines, Ltd. where the famous Cape Blue crocidolite asbestos is obtained. This asbestos is in demand because of its high tensile strength and excellent filtering characteristics. The seams, which reach several inches in thickness, are mined by resuing to ensure a clean product and reduce treatment costs. Reserves are very large at the Koeegas deposit. Delegates not visiting the asbestos deposit visited the South African Mangane Ltd.'s mine and the Sishen iron deposit.

The high grade Tsumeb lead-copper-zinc mine of Tsumeb Corporation Limited with its complex geology and metallurgy and high germanium content was visited by many delegates. The lead and copper smelters and germanium recovery plant now under construction will be in operation in 1962.

The Consolidated Diamond Mines of South West Africa at Oranjemund lie on a bleak rocky coast surrounded on three sides by hundreds of miles of drifting sands of the Namib Desert, where dunes reach heights of 1,000 feet. The deposits extend from a few miles south of the Orange River 50 miles north in a continuous layer of beach gravels as much as one and three quarters of a mile wide and along ancient wave-cut terraces at several levels. These are the richest diamond deposits in the world, over

99 percent of the product being gem-quality stones. Diamond-bearing gravels lie on or near bedrock and are covered by younger barren sand dunes. The productive gravel ranges from a few inches to 10 feet in thickness. Bulk sampling is done by trenches across the entire width of the gravel at intervals of 1,000 feet along the beach. All of the trench material below the younger dune sand is screened, washed, and hand sorted. The diamonds, many of 10- to 20-carat size, are thought to have been brought down the Orange and other rivers from kimberlite pipes inland and spread along old beaches by the strong north-trending ocean currents in this area.

Delegates next visited the Transvaal Development Company Limited's Messina copper mine in the Northern Transvaal. Four mines are being operated over a 10-mile length of the Messina fault. The deposits are unusual in that very coarse-grained chalcopryite, bornite, and chalcocite occur in quartz-filled fractures that formed over the tops of breccia pipes that do not reach surface. Below the vein system the breccia pipes contain the same coarse sulfides and are being mined in large open stopes.

After visiting the gold mining district at Barberton we saw the enormous coal deposits of the Witbank area. A number of mines are operating in this district, where the coal is mainly flat-lying at shallow depths and reaches 30 feet in thickness. Much of the coal is being used for power generation, and a new plant now being constructed, complete with its own coal mine, will be the largest power producer in South

Africa when all units are installed by 1964.

The government-operated iron mine at Thabazimbi is mining high-grade hematite ore formed along strike thrust faults in a banded iron formation. Although the open pit and underground operations are mining only the hydrothermally enriched ore, the banded iron formation, which extends for over 100 miles along strike, contains 30 percent iron that can be upgraded to over 60 percent by roasting and magnetic separation.

The Rustenburg Platinum Mines Limited's mine is on the flat-lying (9°) Merenski Reef which is known to contain minable platinum, copper, and nickel values over large parts of the Bushveld igneous complex. Stope width is 28 inches, which includes 1 to 2 inches of chromite at the base of the reef, 8 to 10 inches of basic pegmatite that contains platinum, copper, and nickel, and an upper zone in pyroxenite that contains copper and nickel. Treatment is by corundum tables, flotation of sulfides, and smelting to produce a copper-nickel matte.

The tours have been arranged so that much of the travelling is done at night on special trains, allowing visits to mines almost every day. As each of the mines seems to be trying to outdo the others in hospitality, the trip is a bit rugged at times, but it is giving all of us an unequalled opportunity to see the great mining industry of South Africa and to experience the warmth of South African hospitality.

The Congress next moves north to visit the mines of Northern and Southern Rhodesia.



A CHARMING CANADIAN delegate, Mrs. R. J. Redrupp with South African delegates J. B. Mudd, H. MacConachie, and A. R. Harrison.



CONGRESS Regional Vice President from Southern Rhodesia, Sir George Davenport and R. S. G. Stokes (left) from England.

Mining World Photographs

THIS IS VANADIUM PENTOXIDE —where is it all going?

by Richard P. Fischer

The world production and use of vanadium has increased rather gradually in the past 50 years, but in recent years some foreign countries have greatly increased their requirements. This change presents a picture that is interesting and somewhat puzzling.

Most of the vanadium used in the United States has come from ores mined in the United States and Peru. The domestic consumption of vanadium increased during the 1950's, but only at a moderate rate. About

80 percent of the vanadium consumed domestically has gone into steel-making, and most of this has been used as ferrovanadium.

Until recently, European supplies of vanadium have been derived mainly from ores mined in Africa.

Before 1955 United States exports of vanadium were small and mostly in the form of ferrovanadium. Since 1955, exports of vanadium have been large and chiefly in the form of vanadium oxide. The recent vanadium imports of some countries greatly exceed the quantity of vanadium generally used for the amount of steel being made by these coun-

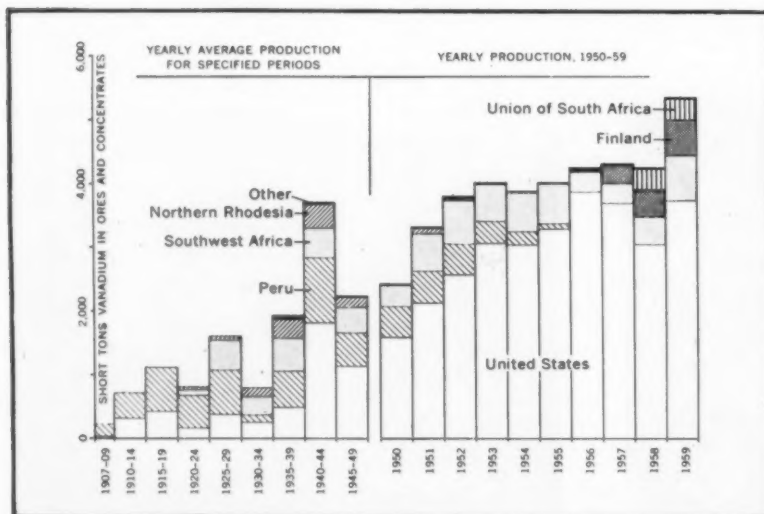
tries, but the manner in which this vanadium is being used has not been reported in domestic trade journals.

All statistical data used in this report are from government publications. Most of the data are from the annual volumes of *Minerals Yearbook* and its predecessor, *Mineral Resources of the United States*, published by the U. S. Bureau of Mines since 1924 and earlier by the United States Geological Survey. Some of the recent data are from *Mineral Market Reports* and from the 1960 monthly vanadium reports, both published by the U. S. Bureau of Mines.

Statistics of production, trade, and use of vanadium show the following salient points:

1. World production of vanadium has increased rather steadily since the early 1900's (Figure No. 1).

2. Domestic production increased rather steadily to 1956, when it leveled off, whereas foreign production increased appreciably in 1958 and 1959 (Figure Nos. 1 and 2B). [Note: In comparing domestic and foreign (European) production or supply, the output from Peru can be considered domestic, for the ore and concentrates have all come to the United States; virtually all other



REPORTED WORLD PRODUCTION of vanadium contained in ores and concentrates; yearly average production for specified periods from 1907 to 1949 and yearly production from 1950 to 1959. **Figure No. 1.**

Mr. Fischer has spent many years in the study of vanadium and is the author of many Geological Survey Bulletins and Reports. He is now a United States Geological Survey geologist, Branch of Radioactive Material, Denver, Colorado. This article has been approved for publication by the Director of the Geological Survey.

foreign ore has gone to Europe.]

3. Reported domestic consumption of vanadium increased moderately during the 1950's (Figure No. 2A). Comparable data on European consumption are not available, but data on European supplies are shown in Figure No. 2B. During the 1950-1954 period European supplies averaged about 650 short tons yearly. This European supply jumped from about 650 tons in 1954 to nearly 1,800 tons in 1955, and during the 1955-1959 period it averaged a little more than 1,650 tons yearly.

4. United States exports of vanadium to European countries (Figure No. 2B) averaged about 50 tons a year during the 1950-1954 period. They jumped from 13 tons in 1954 to about 1,150 tons in 1955. During the 1955-1959 period they averaged about 790 tons yearly. In 1960 United States exports to European countries totaled 3,356 tons.

5. Domestic exports to Canada, the only steady export market during the 1950's, increased rather gradually, averaging 50 tons a year during the 1950-1954 period and 93 tons yearly during the 1955-1959 period (Figure No. 3).

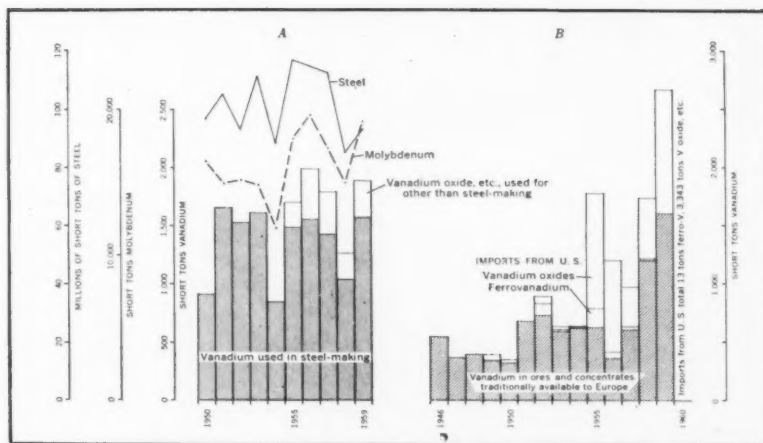
6. From 1949 to 1954, about 80 percent of the vanadium exported from the United States was in the form of ferrovanadium and a little more than half of this went to Canada (Figure No. 3). During the 1955-1959 period only about 14 percent of the vanadium exported was in the form of ferrovanadium, and Canada took most of this; exports to European countries were almost entirely in the form of vanadium concentrates (oxide).

Vanadium sources

The recorded production of vanadium in ores and concentrates is summarized in Figure No. 1. Although some vanadium was produced before 1907, the amount was small, and its source is not clearly recorded. The useful record of vanadium production began in 1907 with the start of shipments from the Minasragra mine, Peru.

The fabulous Minasragra mine has been the world's most productive single vanadium mine. By 1955, when production ceased, it had yielded about 25,000 short tons of vanadium in ores and concentrates, representing about one quarter of the world's total recorded production to that date. The deposit is a vanadium-bearing asphaltite that fills a fracture and impregnates the adjoining shale country rock.

In the United States, minor



APPROXIMATE CONSUMPTION of vanadium and molybdenum in short tons of contained metal and production of steel in the United States, 1950-1959. Vanadium consumption figures for 1955-1959 are compiled by U. S. Bureau of Mines and are estimated to be about 90 percent of total consumption. Data for the 1950-1954 period are compiled by American Iron and Steel Institute and published by the Bureau of Mines; no data are available on vanadium consumption other than for steel-making. **Figure No. 2A.** Represents left side of diagram.

APPROXIMATE CONTAINED vanadium in ores and concentrates traditionally available to European countries and in ferrovanadium (gross weight) and in vanadium oxide (contained vanadium) imported from the United States. **Figure No. 2B.**

amounts of vanadium have been recovered from vanadate minerals in the oxidized zones of base and precious metal deposits in the southwestern states, as a byproduct from phosphate rock mined in Idaho, and from flue dust, but the bulk of domestic vanadium has come from deposits in sandstone in Colorado, Utah, and Arizona. In recent years much of the vanadium produced from these sandstone ores has been a coproduct or byproduct of uranium mining.

Production of vanadate ore from South West Africa began in 1920, and since 1925 it has been quite steady at a yearly average rate of about 500 short tons of vanadium in ores and concentrates. Total production slightly exceeds 16,000 short tons of vanadium, representing nearly 15 percent of the world's total recorded production.

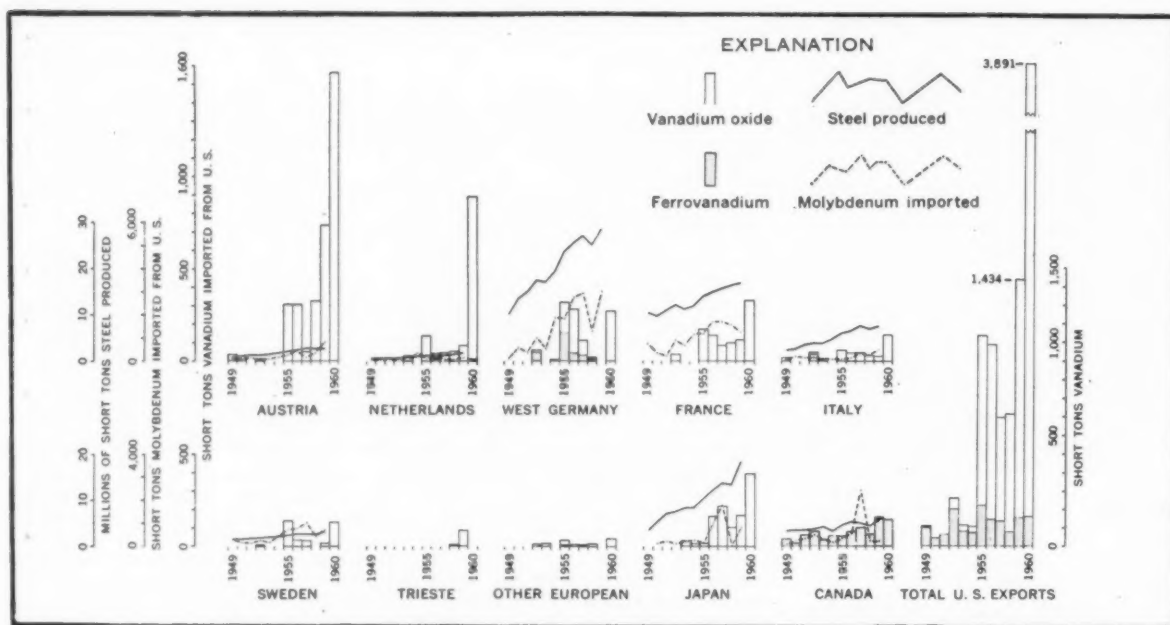
Northern Rhodesia has produced a little more than 5,000 short tons of vanadium in ores and concentrates from vanadate ores. Production began in 1920 and was fairly steady until the late forties; no vanadium production is reported since 1952.

Since 1956 vanadium, titanium, and iron have been recovered from a titaniferous magnetite deposit in Finland. Similar ores in the Union of South Africa have yielded vanadium since 1958.

Other production reported by the U. S. Bureau of Mines includes small

quantities of vanadate ores mined in Mexico, Argentina, and Angola. Some vanadium is also reported to be recovered from vanadate ores in Morocco and Spain, from the treatment of bauxite in France and Germany, and from vanadiferous slags from Norway, but the amounts are not reported and are probably small. During World War II Japan recovered moderate amounts of vanadium by treating titaniferous magnetite beach sands, and Germany recovered large amounts of vanadium from European iron ores; complete production figures are not reported, however, and for that reason Japanese and German wartime production is not shown on Figure No. 1.

The vanadium ores and concentrates produced in Peru have been imported into the United States for refining. This vanadium and that derived from domestic sources constitute domestic supplies and have been largely consumed in the United States. Except for several hundred tons of ferrovanadium shipped to the USSR in 1944, exports of vanadium from the United States had been moderately small until 1955. Traditionally, European supplies have been derived mainly from ores and concentrates produced in South West Africa and Northern Rhodesia. Presumably the vanadium being produced in Finland and most or all of that coming from the Union of South Africa is available to European



REPORTED UNITED STATES exports of ferrovanadium (gross weight), vanadium oxide (contained vanadium), and molybdenum (both ferromolybdenum and molybdenum oxide, etc.) to several European countries, Japan, and Canada; steel production of these countries; and total United States exports of ferrovanadium and vanadium oxide to all countries. Units of less than five tons of vanadium are not shown. **Figure No. 3.**

countries, but the distribution of this vanadium to individual countries is not reported by the U. S. Bureau of Mines.

Vanadium has been used mainly as an alloy metal in steel, and generally this use is said to account for 80 to 90 percent of the vanadium consumed. During the 1955-1959 period, 82 percent of the vanadium consumed in the United States was used in making steel, and 97 percent of this amount (or 80 percent of the total vanadium used) was used in the form of ferrovanadium. The rest was used in nonferrous alloys, chemicals, and minor miscellaneous uses.

Because vanadium has been used mainly as a steel alloy in the United States, its yearly consumption rate is closely related to the rate of steel production. In a like manner, the domestic consumption rate of molybdenum, which also is mainly used as a ferro-alloy, is related to steel production. Thus lines plotting the domestic consumption of vanadium and molybdenum are nearly parallel to one another and to a line showing steel production (Figure No. 2A). Any large deviation from this parallelism would suggest a pattern of use different from the domestic pattern in the 1950's.

Figure 3 shows the amount of vanadium exported from the United States to several European countries, Japan, and Canada, and also total

United States exports, from 1949 to 1960. In addition is shown the annual steel production of these countries from 1949 to 1959, and exports of molybdenum to these countries during this period. Although the molybdenum figures do not necessarily represent the total molybdenum supplies available to these countries, nevertheless as the United States produces more than 80 percent of the world's total, these amounts of molybdenum must represent the bulk of available supplies.

The graph for Canada (Figure No. 3) shows lines of similar slopes for vanadium and molybdenum imports and steel making. The abnormal import of molybdenum in 1957 should be ignored, for it represents large shipments of concentrates that were sent to Canada for refining to oxide because of a strike shut-down of a domestic refinery.

Using this graph of Canada (Figure No. 3) or that of the United States (Figure No. 2A) as a standard, it is obvious that the vanadium imports of Austria in 1955, 1956, 1958, 1959, and 1960, those of Trieste in 1959, and those of the Netherlands in 1960 are out of balance with steel production and molybdenum imports. Individually the other European countries and Japan are not so much out of balance, but collectively it is obvious that there was a large increase in demand in some countries in re-

cent years, as shown by the graph of total United States exports (Figure No. 3). The use being made of this vanadium has not been reported in domestic trade journals.

Summary and implications

The reported consumption of vanadium in the United States and Canada increased during the 1950's, but only at a moderate rate; no surge in requirements like that in some foreign countries is evident in the late fifties. In addition, the published record shows no change in the traditional pattern of using most of the vanadium as ferrovanadium in making steel in the United States and Canada. The foreign demand, however, as shown by exports, shifted almost entirely to the purchase of vanadium oxide instead of ferrovanadium.

Unless these several foreign countries are making much more vanadium alloying material than in the past, it would seem that either a new use for vanadium has been developed or perhaps some of this vanadium is being transhipped to an unknown point of demand.

This increased foreign demand has stimulated domestic interest in producing vanadium, but until more is known about the foreign uses of vanadium, it is difficult to predict how long this demand will continue and at what rate.

END

Metal & Mineral Prices

U. S. A.

June 20, 1961

METALS

COPPER: Electrolytic, Delivered F.o.b. cars, Valley basis (pound) —	31.00c
Lake, Delivered, destinations, USA	31.00c
Foreign, Delivered, destinations, USA	31.00c
LEAD: Common Grade, New York (Per pound)	11.00c
Tri-State Concentrate, 80% lead, per ton	\$125.16
ZINC: Prime Western: F.o.b. E. St. Louis (Per pound)	11.50c
Prime Western: Delivered New York	12.00c
Tri-State Concentrate, 60% zinc per ton	\$68.00
ALUMINUM: Primary 50 Pound Ingots (99.5% plus) (Per pound)	26.00c
ANTIMONY: Lone Star Brand, F.o.b. Lorado, in bulk (Per pound)	\$2.50c
BISMUTH: (in ton lots) price per pound	\$2.25
CADMIUM: Sticks and bars, 1 to 5 ton lots Price per pound	\$1.60
COBALT: 97-99%, keg of 500 pounds (Price per pound)	\$1.50
COLUMBIUM: Ingot	Nominal, per pound \$36.00-\$55.00
GERMANIUM: dioxide, high purity, gram	16.75-21.75c
LITHIUM: 98% (per pound)	\$9.00-\$12.00
MAGNESIUM: Ingots (99.8%) F.o.b. Velasco, Texas per pound	36.00c
MERCURY: Flasks, Small lots, New York	\$200.00-\$204.00
NICKEL: "P" Ingots (3 pounds) F.o.b. Port Colbourne, Ontario	75.50c
PLUTONIUM: To July 1, 1962 AEC will pay \$30.00 to \$40.00 per gram depending on plutonium 240 content. July 1, 1962 to June 30, 1963, per gram	\$30.00
SELENIUM: 99.5% per pound	\$6.50-\$7.00
TELLURIUM: Common grade, Per pound	\$5.25
THORIUM: per kilogram	\$43.00
TIN: Grade A Brands, New York (Per pound) Prompt delivery	113.00c
TITANIUM: 99.3% + Grade A-1 Sponge (Per pound)	\$1.50-\$1.60
URANIUM: Normal, Per Pound	\$24.00
VANADIUM: 90% Grade	\$3.45
GOLD: United States Treasury Price	\$35.00 per ounce
London	\$35.16 per ounce
SILVER: Newly mined domestic, U.S. Treasury price per ounce	91 3/4c
Foreign Handy Harmon	\$82.00-\$85.00
PLATINUM: Per ounce	\$5.00
ZIRCONIUM: Sponge, Per pound, Reactor Grade	\$5.00

ORES AND CONCENTRATES

BERYLLIUM ORE: 10 to 12% BeO, F.o.b. mine, Colorado	\$46.00 per unit
Small lot purchases at Custer, S. D., Spruce Pine, N. C., and Franklin, N. H. Visual inspection at \$400.00 per short ton or by assaying at 8.0 to 8.9% BeO, \$40 per unit; 9.0 to 9.9%, \$45; over 10.0%, \$48.00.	
CHROME ORE: F.o.b. railroad cars eastern seaports. Dry long tons.	
African (Rhodesian), 48% Cr ₂ O ₃ , 3 to 1 ratio	\$35.00-\$36.00
African (Transvaal), 48% Cr ₂ O ₃ , No ratio	\$26.00-\$28.00
Turkish, 48% Cr ₂ O ₃ , 3 to 1 chrome-iron ratio Nominal	\$36.00-\$37.00
U.S. Government ore-purchase depot Grants Pass Oregon. Buying suspended, quota filled.	
COLUMBIUM-TANTALUM ORE: Per Pound Pentoxide, Nominal	\$1.10
IRON ORE: Lake Superior. Per gross ton Lower Lake Ports	
Mesabi, Non Bessemer, 51.5% Fe	\$11.45
Mesabi, Bessemer, 51.5% Fe	\$11.60
Old Range Non Bessemer	\$11.70
Old Range Bessemer	\$11.85
Lump: Plus 1/2-inch	\$12.85
Fines: Minus 1/2-inch	\$10.72
Swedish, Atlantic Ports, 60 to 68% Fe Contracts, Per Unit	24.00-25.00c
Brazilian, Atlantic Port, 68 to 90%, Long ton unit	22.00-22.50c
Venezuelan, Orinoco No. 1, 58% Fe, f.o.b. Puerto Ordaz	\$8.95
MANGANESE ORE: Metallurgical grade, 48 to 50% Mn Long ton unit	\$0.90-\$0.95
Metallurgical grade, 46 to 48% Mn. Long ton unit	\$0.85-\$0.90
Metallurgical grade, 44 to 45% Mn. Long ton unit	\$0.85-\$0.90
Domestic U.S. Government, GSA Basis \$2.30 per unit for 48% Mn.	
MOLYBDENITE CONCENTRATE: 90% MoS ₂ , F.o.b. Climax, Colorado, Per pound and Mo, plus container cost	\$1.40
TUNGSTEN CONCENTRATE: Domestic, 60% WO ₃ Per short ton unit	Nominal \$23.50
Foreign: 65% WO ₃ Per short ton unit (Scheelite)	Nominal \$17.00
Foreign: South American, Spanish, Portuguese	Nominal \$16.50
URANIUM ORE: F.o.b. purchase depot or company mill in accordance with AEC schedules and company buying contracts. Basic price is \$1.50 per pound of U ₃ O ₈ in ore assaying 0.10 percent. For each additional 0.01 add 20¢. Subject to development allowance, premiums, penalties where applicable.	

NON-METALLIC MINERALS

BARITE: Oil well drilling. Minimum 4.25 specific gravity, or short ton	\$14.00
BENTONITE: Minus-200mesh, F.o.b. Wyoming. Per ton, carload lots	\$12.50
Oil Well grade. Packed in 100 pound paper bags	\$14.00
BORON: technical grade F.o.b. Baron California. Per ton	\$47.50
FLUORSPAR: Metallurgical grade, 72.5% effective CaF ₂ content per short ton F.o.b. Illinois-Kentucky mines	\$37.00-\$41.00
Mexican, 70% F.o.b. border. Duty paid	\$26.00-\$27.00
Acid Grade, 97% CaF ₂ , Bulk, F.o.b. mine	\$45.00-\$49.00
PERLITE: Crude: F.o.b. mine per short ton	\$3.00 to \$5.00
Plaster grades, Crushed and sized, F.o.b. plants	\$7.00 to \$9.00
SULPHUR: Long ton, f.o.b. cars, mines	\$22.50-\$23.50
F.o.b. vessels Gulf Ports	\$24.00-\$25.00

London

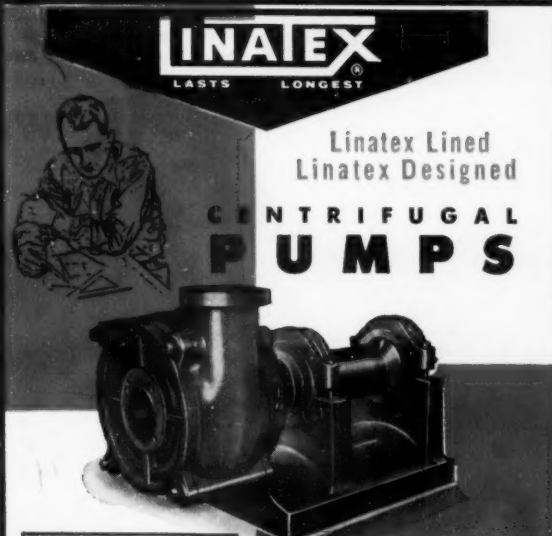
June 20, 1961

	Per Long Ton USA Equivalent cents per pound
COPPER: Electrolytic, spot	£233 15s 0d 29.22c
LEAD: Refined 99%	£ 64 5s 0d 8.03c
ZINC: Virgin, 98%	£ 77 10s 0d 9.69c
ALUMINUM: Ingot, 99.5%	£186 0s 0d 23.25c
ANTIMONY: Regulus, 99.6%	£230 0s 0d 28.75c
TIN: Standard, 99.73%	£879 10s 0d 109.94c
TUNGSTEN: Long ton unit	£ 0 12s 0d 18.06c

*With Sterling Pound at \$ 2.80

Quotations on metals and certain ores through the courtesy of American Metal Market, New York, New York

JULY 1961

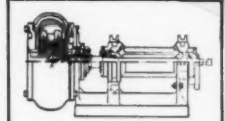


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LIVERMORE, CALIFORNIA

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Most problems of equipment wear are complicated by several wear factors, such as impact, abrasion, heat and corrosion. Choosing the best alloy for any set of conditions requires long experience plus an adequate selection of materials. Here's why **STOODY**, pioneers in hard-facing, gives you more for your hard-facing dollar and eliminates costly experimentation.

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STOODY 102	STOODY 110
STOODY 103	STOODY 115
STOODY 104	STOODY 121
STOODY 105	STOODY 130
STOODY 106	STOODY 134
STOODY NICKEL MANGANESE	

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STOODY NICKEL MANGANESE	STOODITE
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STOODY 1027	STOODY 1
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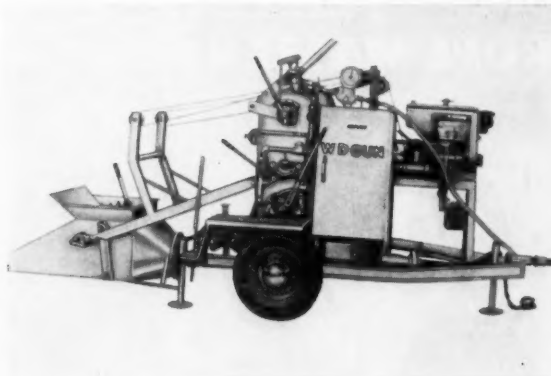
PRODUCTION EQUIPMENT preview

FOR DATA ON ANY ITEM IN THIS SECTION PLEASE WRITE MANUFACTURER DIRECT



Maneuverable Truck Has Short Wheelbase

K-W Dart Truck Company has announced production of its new model 32S truck that will deliver 32 tons of payload on a short wheelbase. Engine is Cummins V8-350, 350 horsepower Diesel; unit-mounted, heavy-duty transmission provides 10 speeds forward, two reverse; torque converter is optional. Hi-tensile strength steel has been used extensively throughout body and frame reducing parasitic weight to a minimum. Write: **KW-Dart Truck Company, Dept. MW, 1301 North Manchester Trafficway, Kansas City 20, Missouri.**



Portable Wet or Dry Pressure Grouting Gun

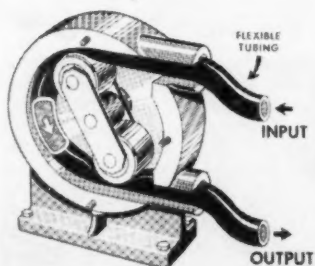
The first fully portable gun capable of both wet or dry gunning and pressure grouting has been introduced to the mining industry. The new WD gun provides positive flow control with a continuous feed from a single outlet for uninterrupted flow of material, wet or dry, and you can change instantly from one method to the other. Production rates vary from four to eight cubic yards per hour. Write: **Air Placement Equipment Company, Dept. MW, 1012A West 25th Street, Kansas City 8, Missouri.**

Unusual Pump Design Prevents Contamination or Corrosion by Use of Flexible Tube

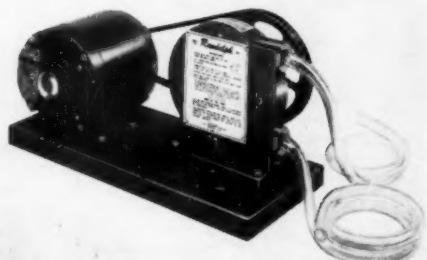
A pump that never gets wet is the Randolph Pump operating on a principle designed to eliminate all contact of moving parts with the fluid being pumped. Intake and outlet are one continuous flexible tube which passes through the pump body where it is exposed to the squee-gee action of ball-bearing rollers.

By selecting tubing material suitable to the liquid being handled, a wide variety of corrosive, sterile, and abrasive liquids or gases can be pumped without contamination or injury to the pump.

The Randolph pump comes in two sizes, 54 and 185 gallons per hour, and its versatility has resulted in its im-



mediate acceptance by many diverse industries utilizing processes where corrosion, contamination or abrasion were



once a problem. Write: **The Randolph Company, Dept. MW, 1018 Bosinge St., Houston 19, Texas.**

Lube-Free Variable Speed Drive

Sterling Electric Motors, Inc. has introduced a new "Lube-Free" variable speed drive that never requires lubrication. All bearings, sealed and shielded, are factory-lubricated, and shaft surfaces are impregnated with a special exceptionally tough and wear-resistant material which eliminates need for lubrication. The non-metallic bushings are also fabricated from a special material that is equally wear-resistant. Write: **Dept. B1, Sterling Electric Motors Inc., Dept. MW, 5401 Telegraph Road, Los Angeles 22, California.**

For Standby Electric Power

A new series of Winco engine generators to provide standby electric power in the event of power line failure is announced by Wincharger Corporation.

The "91" series produces 9,000 watts of AC intermittent duty power, or 7,500 watts of continuous power. It powers a 3 horsepower and a 2 horsepower motor, or a 5 horsepower motor, plus 2,500 watts of resistive load on its 230 volt circuit; or two 2 horsepower motors plus 3,500 watts of resistive load on its 115 volt circuits. Write: **Wincharger Corporation, Dept. MW, Sioux City, Iowa.**

Blasting Manual Available

Publication of Supplement No. B to the second edition of the "Manual of Rock Blasting" has been announced by Atlas Copco. This supplement contains articles on "Sub-Marine Rock Blasting," "Steel Grades for Rock Drill Steels with Carbide Bits," "Tungsten Carbide Drill Steels for Hammer Rock Drills," and "Explosives for Rock Blasting."

The price has been established at \$7.00 for Supplement No. B, and copies may be obtained by writing: **Atlas Copco Pacific, Inc., Dept. MW, 930 Brittan Avenue, San Carlos, California.**

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SWIVEL SHACKLE
FLAT TYPE SHACKLE
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INCREASE WIRE ROPE LIFE —
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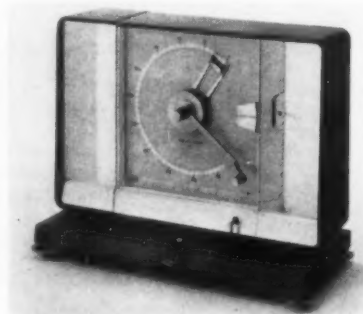
1125 S. E. Grand Avenue
Portland 14, Oregon

Complete Mobile Radio Control

General Electric has published a new bulletin, ECR-793, entitled "Complete Control with Two-Way Radio." It describes how mobile communications integrates operations of any business where vehicles are used. All of a company's vehicles can be put on a single system or set up on separate networks. Write: General Electric Communication Products Department, Dept. MW, P. O. Box 4197, Lynchburg, Virginia.

Trucks Can't Damage This Hose

A water suction hose designed especially for use where hose is subjected to damage from truck movements is being marketed by The Goodyear Tire & Rubber Company. Identified as "Rebound" because it springs back to its original shape after being completely crushed, the hose is being produced in lengths to 25 feet, and in one and one-half inch and two inch diameters. Write: Goodyear Tire & Rubber Company, Dept. MW, Akron, Ohio.



New Precision Balance

A revolutionary new precision balance called the Model L Precision Balance has been introduced by Federal Pacific Electric Company for rapid precise weighings in the fields of research, production, quality control, and analytical work.

The new balance, which is of double hook design, fills weighing needs in a range as low as 0-3 mg or as high as 0-50 grams. By means of its counterweighing ability, loads up to three times scale value can also be weighed. Write: Federal Pacific Electric Company, Dept. MW, 50 Avenue L, Newark 1, N. J.

Coke Ovens for America

Arthur G. McKee & Company of Cleveland, Ohio, has entered the coke oven construction field through an agreement with Firma Carl Still of West Germany under which McKee has been licensed to build coke ovens of the Still design in the North American Continent.

Multi-stage heating makes possible the construction and operation of ovens up to 20 feet in height compared with those of 10 to 14 feet in height now in general use in the United States. Write: Arthur G. McKee, & Company, Dept. MW, 616 Hanna Building, Cleveland 15, Ohio.



Versatile Bulldozer Blade

The Model 6H Varidozer, made by Ulrich Manufacturing Company, is a completely different utility bulldozer blade with an almost unlimited range of hydraulically-controlled blade positions. The Varidozer can be changed in seconds from a straight blade to an angle blade, forward "V," reverse "V," tilt blade, or to any combination of these positions. The entire cycle of positions is controlled by four hydraulic levers mounted beside the tractor seat, giving instantaneous finger tip control of the blade, under full load or empty, while the machine is moving in either direction. Write: R. M. Ulrich, Ulrich Manufacturing Company, Dept. MW, Rockford, Illinois.

Idlers Offer Easy Lubrication

A new troughing idler, called Style L, is now being offered for rope stringer conveyor systems. The new idler offers simple installation, rugged construction, and easy lubrication with six bearings lubricated from one grease fitting. Write: Hewitt-Robins, Dept. MW(L), Stamford, Connecticut.



New Clamp Volt-Ammeter

The new Elima Clamp Volt-Ammeter is an extremely handy instrument for checking currents and voltages on the spot. It is ideal for electrical engineers, electricians, servicemen, motor repair shops, etc. It is available in two models each with 4 AC current ranges and 2 AC voltage ranges. Currents from below 1 amp up to 300 amp and 600 amp can be measured. This handy instrument is made in West Germany and distributed in the United States by Epic, Inc., Dept. MW, 154 Nassau Street, New York 38, New York.

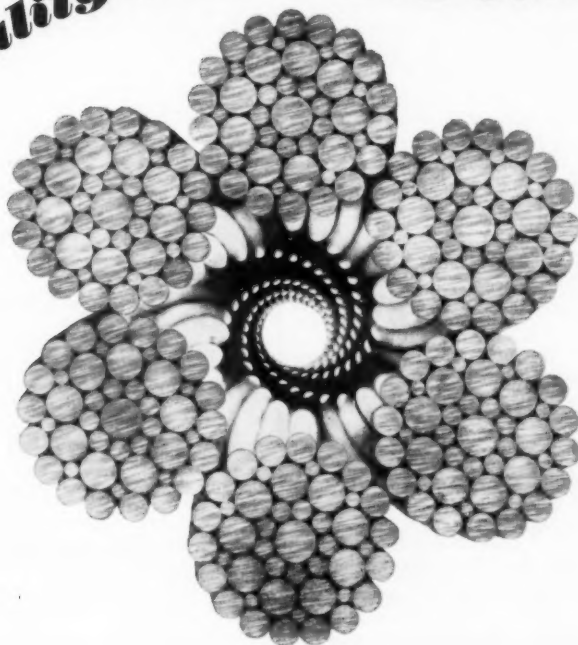
Any way you look at Roebling Royal Blue Wire Rope, there's real savings in it for you. In its inner and outer uniformity. In its extra-high strength. In unison, these qualities provide unrivalled resistance to abrasion, impact, crushing and tough sheave pressures. Royal Blue—inside and

outside—goes on paying off for you when lesser wire rope would need replacing. Find out more from your wire rope distributor, or write for free booklet to Roebling's **ROEBLING** Wire Rope Division, Trenton 2, New Jersey.

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quality inside and outside



We put a lot of work into it —
You get a lot of work out of it

If
you
have a
weight
problem...



Our business is solving other people's weight problems. Usually, these problems involve wanting to know exactly how much weight passes over a conveyor in a given time period. Often, the problem is to control the flow of material into a continuous mixing process. And frequently, somebody asks us to help him automate a complete process system, with interlocks, time delay relays, and complete circuitry control systems.

All the problems we solve have two things in common: measurement or control of the amount of material *by weight*, which is a far more accurate way of doing it than by volume; and secondly, the fact that the material is *in transit* during the weighing and controlling.

... there are a number of solutions.

In our existing line of Weightometers® and Feedweights®, we now have so many different types of standard equipment . . . at last count, it was approaching 200 . . . that there is virtually no existing set of requirements that at least one of them can't answer. We can give you electrical, electronic, hydraulic or mechanical systems. And in the very rare cases where one of our standard models can't be used, we'll engineer one for you.

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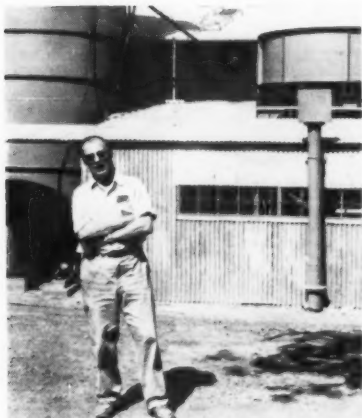
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WHAT'S GOING ON in mining



M. A. JORGENSEN, chief metallurgist, in front of new pilot plant. Many of you knew him at Ibarado in Colorado.



VERTICAL SHAFT, 300 feet deep, from which cross cuts follow diamond drill holes for bulk test sampling.



SAMPLE preparation plant cuts assay or pilot plant sized samples from large lots.
Mining World Photographs

SOUTH AFRICA . . .

Rio Tinto Seeks Palabora Copper Grade and Mill Flowsheet

by MINING WORLD'S Special Travelling Correspondent

The Palabora igneous complex of the Northeast Transvaal with its much debated carbonatite ring structure, was the preserve of the mining geologist for many years. A carbonatite has been defined as "Rocks formed as a phase of a magma that was both rich in soda and lime, as well as being in a highly carbonated condition." It gave zest to the declining years of the most imaginative and creative of all South Africans of that profession, the late Dr. Hans Merensky. Lately, the miner and metallurgist have taken over, with harsh problems of economics thrust upon them at every turn.

The activities of the government's "Foscor" Company, aiming to produce all the phosphate concentrate required to serve the Union's super-phosphate needs, and of the Transvaal Ore Company (a direct Merensky inheritance), exporting over 50,000 tons of graded vermiculite annually, have been largely overshadowed by the rise in their midst of a great prospective copper producer. This is Palabora Copper Company—Rio Tinto Company of South Africa Limited, Newmont Mining Corporation, Palabora Holdings Limited, and Transvaal Ore Company

Ltd. And all this industrial diversity is displayed in an area of only four square miles, within the eight miles composing the complex as a whole.

Prospecting of the central carbonatite core has been in progress by means of adits into the hillside and by diamond drilling since 1953 by the Palabora Company, and by earlier holders of the ground.

The inner, carbonatite, core is said to show a grade of well over 1.0 percent copper, with a declining content—and no sharp cut-off—into the peripheral rocks, but no doubt this is over-simplification of zonal distribution. Open pit contours directly related to the final cubing-up of the mineable ore have been checked. Unofficially, the magnitude of the payable deposit may be pictured at 30,000,000 tons per 100 feet of vertical depth. For the copper, a grade of 0.7 percent giving an extraction approaching 0.6 in concentrate.

M. A. Jorgenson, with a new test plant

equipped with most flexible and complete sampling, grinding, flotation, and magnetic separation units, experiences special difficulties owing to the intimate association of much of the copper with the slightly-titaniferous magnetite, constituting 25 percent of the ore to mill. Valleriite ($\text{Cu}_2\text{Fe}_2\text{S}_7$) which resembles pyrrhotite in color and graphite in physical properties presents a problem because it adheres to the magnetite.

Cheap power from an Eastern Transvaal thermal power station, ample water from the Olifants River, and adequate rail facilities over the 226 miles to Lourenço Marques, upon construction of a branch line—all would be essential to success. Transportation services will demand special overhaul.

Palabora is a striking example of the old truth that the credit for mine discovery may often belong less to the finder of the minerals than to the engineers and their financial backers first proving its economic worth to make ore.

CHILE . . .

Mitsubishi Now Mines and Ships High-Grade Iron Ore to Japan

Iron ore shipments to Japan have started from the new mechanized ore loading port of Calderilla, Chile. Ore from the Adrianitas mine of Compania Minera de Atacama Ltd. is shipped through the port to Japanese steel mills. Port capacity is 500,000 annual tons and

studies are now underway to double this capacity.

Shipment of the ore culminates a five-year program of Mitsubishi Mining Ltd. and Mitsubishi Shoji Kaisha Ltd. to develop iron ore sources in South America. The two firms own Minera Atacama which operates the open-pit

mines and port. The mines are 15 kilometers north of Copiapo and ore is trucked 60 kilometers over a new road to the port. Hard magnetite ore occurs in veins and massive ore bodies with initial production mined from two deposits. Plans are underway to mine several other bodies.

"FLEXIBILITY AND LOW UPKEEP COSTS MAKE FLYGT PUMPS AN ADVANTAGE,"

reports
**LUCKY FRIDAY
SILVER-LEAD
MINES CO.
Mullen, Idaho**

While working a 750' shaft-deepening project from the 2300 to 3050 foot level, the Lucky Friday Mine ran into a dewatering problem which required pumping out an average of 150 to 175 gpm. At the start of sinking operations, air pumps were used, but because of periodic extra volume water seepage and excessive repair and maintenance costs, the air pumps were abandoned in favor of Flygt Model B-80L Electric Submersible Pumps.



In the pumping cycle, a Flygt Pump was lowered to the shaft bottom as soon after each blast as possible, and the water was lifted to relay pumps at a higher level, with heads up to 80 feet. The Mine Engineer, in a paper on the operation delivered before the Northwest Mining Convention, said of the Flygt pumping method: "Although the initial cost seemed high at first, the absence of expensive upkeep and the efficient pumping performance justified the investment. The quiet operation of the Flygt was a decided relief after listening to the siren-like air pumps. The Flygt Electric Pump was a distinct improvement over any type of air pump where large volumes of water had to be moved from the shaft bottom. It was low in upkeep cost and its unusual flexibility made it a definite advantage."

Since shaft sinking was completed, two Flygt Model B-80L Pumps now have become a part of the Lucky Friday's permanent mine pumping installation. In service since October 1956, they still are performing with a maximum of efficiency and a minimum of upkeep.

Additional satisfied users of Flygt Pumps in mining applications include Climax Molybdenum Mines in Colorado, Inspiration Copper Mine in Arizona, Kermac Nuclear Fuels in New Mexico, Boyles Bros. Drilling Co. in Utah, Utah Construction Co. in San Francisco, San Manuel Copper Mine in Arizona, White Cap Gold Mining Co. in Nevada, and others.

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Alaska

An active exploration and diamond drilling season has started in Alaska. The largest program again will be carried on by **Bear Creek Mining Company (Kennecott Copper Corporation)** at its **Ruby Creek** copper deposit in the Kobuk district. Drilling over the last several years has indicated an important deposit with very good copper values. The **Mt. Andrews Mining Company (Utah Construction Company)** has several geological parties in the southern part of the Panhandle exploring and drilling for both iron and copper. The **Little Squaw Mining Company** from Spokane, Washington, will continue gold lode development at its high grade property at Chandalar. **Alaska Mines and Minerals, Inc.** continues its mercury mining and furnacing operations at the **Red Devil** mine.

Complete details of **Columbia Iron Mining Company's** option to lease and operate the **Klukwan** iron deposit are now available. The May 1961 issue of **MINING WORLD** first reported the option had been exercised. The agreement includes payment of a minimum yearly royalty of \$45,000 for the first 10 years, and \$100,000 minimum thereafter. The agreement extends for 75 years, but can be terminated by Columbia on 90 days' notice. The property presently consists of 91 lode claims and 92 placer claims plus 103.67 acres purchased outright and 869.94 acres held by leases from Indians. Eight claims are in dispute with the University of Alaska. Columbia may purchase the property at any time during the agreement for \$10,000,000, against which sum all royalties and rentals paid prior to the purchase may be credited. The agreement is with the **Klukwan Iron Ore Corporation**, about 65 percent of which is owned by **Quebec Metallurgical Industries**, which in turn is controlled by **Ventures, Ltd.**, of Canada. Estimates of a few years ago put recoverable iron from the placer claims alone at over 100,000,000 tons of 60 percent magnetite concentrate. The claims are 23 miles northwest of Haines.

Mr. and Mrs. Carl C. Wikstrom, owners and operators of the **Riverside** mine at Hyder, Alaska have recently purchased a 12-ton Gibson mill to replace the 5-ton Gibson mill now in use at the mine. They also have signed a lease on the **Indian** mine in nearby British Columbia which they plan to reactivate this summer. The lead-zinc ore will either be milled at the **Riverside** or shipped depending on grade. The **Silbak Premier Mines Ltd.** operated the **Indian** one season. Ore will be transported over an aerial tram from the **Indian** to the **Premier**. The May issue of **MINING WORLD** erred in reporting that **Hyder Mines Inc.** shipped 12 tons of concentrates to the smelter at East Helena, Montana. The shipment was made by Mr. and Mrs. Wikstrom who purchased the mine from the J. H. Scott interests on October 29, 1960.

United States Smelting, Refining & Mining Company will operate only dredges Nos. 5 and 6 in the Nome area this year, and only four dredges around Fairbanks. Dredges Nos. 2 and 6 at Fairbanks will finish their ground this year, leaving only dredge No. 3 (**Chatanika**) and dredge No. 10 (**Cripple Creek**) operating in the area. Dredges on the Ho-

garza River and at **Chicken** will continue to operate for the foreseeable future.

Arizona

Phelps Dodge Corporation has paid \$22,000 to **International Molybdenum Company** on its purchase contract for **International's** **Copper Basin** copper claims. An additional \$8,000 is due and according to reports will be paid when certain of **International's** claims are patented. If, and, when **PD** operates the properties it will pay a \$0.03 royalty per ton of ore treated. **International Molybdenum** is a Canadian company which owns **Copper Basin** through a 100 percent owned subsidiary—**International Ranwick Limited**.

San Manuel Copper Corporation is scheduled to start mining "Arizona State Lease" ore at its **San Manuel** mine in Pinal County this summer. **San Manuel's** mining schedule calls for some production from State leases for the next five years with continual production, of course, from its own claims.

The **Marvel Mining Company**, Salt Lake City, Utah, has started exploratory drilling at the **Mineral Hill** copper property in Yuma County, Arizona. This property is in the **Planet** district, near the old **Planet** mine. A crew of six men is employed, with company field offices at the **Desert Winds Motel** in Parker, Arizona. Company officials include **Joseph A. Minton**, president; **Duncan E. Harrison**, mining engineer and vice president, and **Louis W. Cramer** of Salt Lake City, consulting geologist.

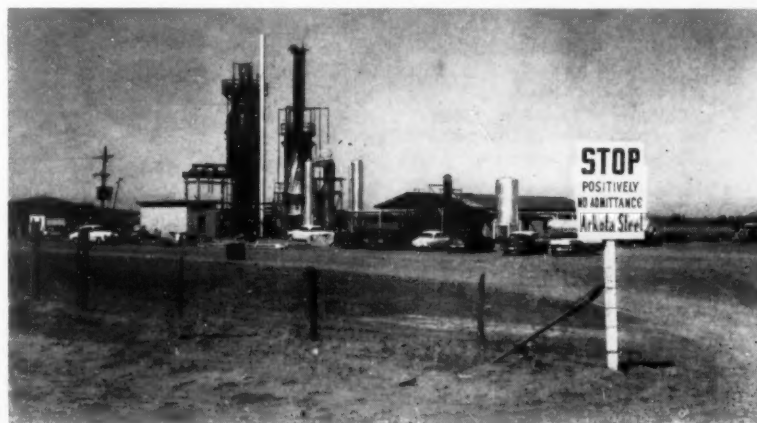
The **B. S. and K. Mining Company** is working three shifts daily in sinking its

new vertical shaft at the **Atlas** mine in the **Silver Bell** district of Pima County, Arizona. Present plans call for sinking the shaft—six feet by nine feet inside measurements—to a depth of 500 to 600 feet. Regular mining and milling of zinc-copper ores continues with the mine on one shift daily and the mill three shifts. The company employs 29 men: 15 in the mine, five in the mill, and nine on shaft sinking. **Milton Reeves** is in charge of shaft sinking and also serves as mill superintendent. **A. M. Kalaf** of Phoenix is company president.

Yucca Mining and Milling Company has been running its milling plant intermittently for the last five months, handling from 400 to 600 tons of ore monthly. The ore is primarily zinc-copper with smaller values in silver and lead. Full-scale operations are said to have been handicapped by a water shortage. **Ben Williams, Sr.**, of Douglas, Arizona, is president of the company and **Mason Ranken** of Yucca is manager. The mine is located in the **Cedar Valley** district of Mohave County, Arizona.

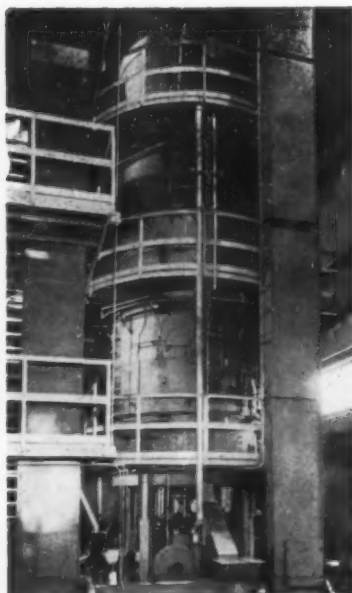
Harold Ferrin, Mesa, Arizona, geophysicist, and his **Sierra Diamond Drilling Company** are developing the **Silver Creek Grubstake** group of gold placer claims in the **Oatman** mining district of Arizona. Geophysical work and 13 drill holes have indicated a low-cost open-pit mining operation. **Daybreak Uranium, Inc.** of Spokane, Washington, has acquired an interest in the group.

Drilling at the **Palo Verde** mine of **Banner Mining Company**, Tucson, Arizona, is said to have indicated a reserve of about 58,000,000 tons of pit-grade ore. Development work, following the completion of the 960-foot shaft, is in



"Vest-Pocket" Arizona Steel Plant Plans July Production

The **Arkota Steel Company**, building a small mill near Coolidge, Arizona, plans first production in July of this year. Using the experimental iron and steel process developed by **Julius D. Madaras**, president of **Madaras Corporation**, the new \$1,000,000 plant is foreseen by some as the forerunner of many "vest-pocket" sized steel plants to be built around the world. The operation will utilize extensive local black sand deposits, reportedly containing 5 to 15 percent Fe, which will be recovered on a magnetic belt. This concentrate, containing about 50 percent iron, will then be fed to the plant which uses several newly developed methods of direct reducing iron ore into usable iron. First, the concentrate is further processed to make it even higher grade. Then the gas-fired reducing process removes the oxygen, resulting in a sponge iron about 95 percent pure. The patented process bypasses the coke plants and blast furnace process of smelting iron ore. Finally, the direct reduction process is hitched to a small electric furnace for converting the sponge iron into usable steel. First production, expected to be between 75 and 100 tons a day, is to be in the form of ingots and billets only. Diversification of products will come with later expanded capacity.



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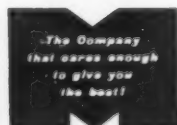
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progress on three levels—the 700, 800, and 900—and about 300 tons of ore per day are mined from development headings. Exploratory drilling on adjacent claims is continuing. The Palo Verde ore is said to be an extension of the American Smelting and Refining Company's Mission ore body where Asarco is spending approximately \$43,000,000 in preparing the property for production. Banner's underground mine—the Daisy, also in the Tucson area—has been closed down for some time so that Pima Mining Company can extend its pit and mine about 1,800,000 tons of Banner ore by open-pit methods.

In its report for the first quarter of the current year, Inspiration Consolidated Copper Company, Inspiration, Arizona, stated that surface construction at the Christmas mine had progressed on schedule. Hoisting facilities are nearing completion, heavy crushing equipment is in place, and installation of auxiliaries is well advanced. The concentrator footings and foundations have been completed and installation of heavy grinding equipment has started. At the end of March, the McDonald shaft had been sunk to 1,741 feet and concreted to 1,716 feet. Planned depth is 1,780 feet. On the same date the No. 6 ventilation shaft had been sunk to 1,002 feet of its planned depth of 1,205 feet, and concreted to 990 feet. The additional pumping capacity had been installed and is capable of handling considerably more than the current inflow of water, stated H. Myles Jacob, president. As soon as the McDonald shaft is completed, driving of the 1,600 main haulage level will be started from this shaft, as well as from the development shaft where three headings are already underway. Delays resulting when a greater-than-expected inflow of water was encountered on the 1,600 level of the No. 3 shaft may prevent operation of the completed plant until sometime in the first half of 1962.

California

The U. S. Bureau of Mines is seeking information from chemical companies in California and Nevada about their consumption of non-fuel minerals and metals. All mining companies making any such sales are asked to communicate with W. W. Key, U. S. Bureau of Mines, 555 Battery Street, San Francisco 11, California.

Reports from Boron, California indicate that a joint venture between Cyprus Mines Corporation and Kern County Land Company will reopen the old Little Placer boron mine which is also known as the old Western mine owned by the California Borate Company. Cyprus reopened the mine several years ago but made no production.

A bequest from the estate of the late Martin J. Heller, totalling some \$1,500,000, has been received by the mining department of the University of California at Berkeley for establishing fellowships for graduate research in mining and mining engineering. A few fellowships, which range from \$3,500 a year on the master's level to \$4,500 a year on the doctoral level, are available for the academic year 1961-1962. Complete details may be obtained by writing to the Graduate Advisor, Mining and Geological

Engineering, Hearst Mining Building, University of California, Berkeley 4. Applicants will be selected on the basis of recommendations and their academic records for study in mining engineering, geophysics and geochemistry; mineral exploration engineering, and certain phases of mineral beneficiation and extractive metallurgy. Fellowships are open to graduates of recognized engineering schools throughout the Free World toward advanced engineering degrees. Fellowships are for an 11-month period; those for the master's degree are not renewable and those for the doctor's degree are not renewable for more than two years beyond the master's degree. Additional funds are available for research expenses.

Central

Sell Missouri Nickel-Cobalt Calcine to Canadian Refiner

The federal government has sold 3,431 tons of byproduct calcine assaying 19 percent nickel, 13 percent cobalt, and about 3.0 percent copper to Sherritt Gordon Mines Limited, Toronto, Canada, for approximately \$900,000. Included in the overall purchase was an additional 87 tons of nickel-cobalt-copper matte.

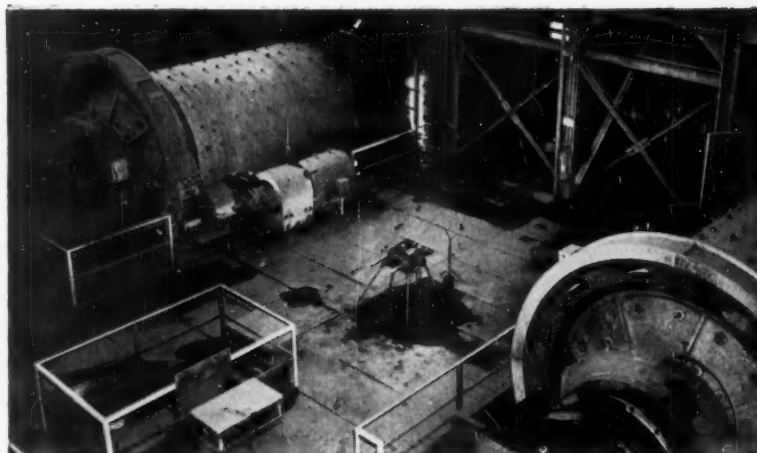
National Lead Company was operator of the government owned chemical refinery at Fredericktown, Missouri, that produces the calcine from ore mined by National Lead. The refinery was operated to recover cobalt for sale to the government. When the cobalt purchase contract was completed National Lead closed its underground mine on January 31 and the refinery soon after.

Sherritt Gordon will ship the calcine to its Fort Saskatchewan, Alberta, Canada, refinery for further refining. This refinery which was built to treat nickel concentrate from Sherritt's Lynn Lake mine, as well as custom concentrates, has been operating below capacity for some time. Sherritt will use the Missouri calcine to produce cobalt wire, strip, and rod as well as recovering the nickel.

Ozark-Mahoning's Parkinson shaft, west of Humm's Wye, Illinois, was shut down recently because of flood water in the nearby Big Grand Pierre creek. Because the collar of the shaft had been built up above a previous flood crest, and a plate placed on the collar to seal it and prevent surface water from entering the shaft, the mine was not actually flooded. Anticipating flood conditions, most of the equipment was removed from the mine though underground pumps were kept operating. Harold Bailie is general superintendent of this lead-zinc-fluorspar producer.

St. Joseph Lead Company vice president Charles R. Ince stated at the annual meeting that there are definite signs that lead and zinc markets may have turned the corner, and prices of both metals should increase before the end of 1961. St. Joe's new Viburnum mine will produce one-third of southwest Missouri's lead output of 100,000 tons this year, and modern machinery has materially reduced the cost of production.

The new zinc mine to be developed by American Zinc, Lead and Smelting Company and Tri-State Zinc, Inc. near



Marcy Scrubbers

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A prominent mining company in Minnesota is using two 9½' x 19½' Marcy Heavy Duty Scrubbers in one of its concentrators, on a tough iron ore cleaning problem. This installation followed use of Marcy Scrubbers in two of the company's other concentrators.

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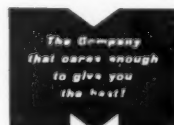
- The Marcy principle of small diameter, long length scrubbers gives...
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New Market, Tennessee, is on a 1,900-acre property, and will enable American Zinc to increase concentrate production by 45 to 50 percent. The mine shaft of the \$6,000,000 project will be collared in Nolichucky shale, and will be 1,500 to 1,600 feet deep. All zinc mined is expected to be lead free and will command a premium price. Since both mine and mill will be highly mechanized, only 150 men will be required for the operation.

A large-scale expansion program, which will probably cost \$125,000,000, is being undertaken by **Tennessee Corporation**, which last year acquired **Miami Copper Company**. The project will include a big ammonia plant at East Tampa, Florida, with the ammonia product to be used in manufacture of a high-analysis fertilizer. Phosphate for the fertilizer is mined by Tennessee Corporation in Florida and central Tennessee, while sulfuric acid used in the process is produced at the corporation's sulfide mines at Copperhill, Tennessee.

Colorado

Vanadium Corporation Gets New U₃O₈ Purchase Contract

The Durango, Colorado uranium mill of the Vanadium Corporation of America will continue to operate through December 31, 1966 under terms of a new contract with the United States Atomic Energy Commission. VCA may deliver 800,000 pounds of U₃O₈ before April 1, 1962 and 800,000 pounds annual thereafter.

The deliverable quantity derived from company-controlled ores may range from approximately 400,000 to 450,000 pounds annually depending upon the amount of production from independent ores. Should independent production exceed 398,880 pounds before April 1, 1962 or 348,880 pounds annually after that date, maximum annual deliveries may be increased.

During the period July 1, 1956, through June 30, 1960, independent producers supplied approximately 41 percent of the ore for the VCA mill.

AEC's first uranium concentrate procurement contract with VCA was signed in May, 1947, and provided for the purchase of concentrates produced in the company's Naturita, Colorado, mill which discontinued operation in 1958. The first Durango purchase contract was signed in February, 1949, and has been revised and extended several times.

Climax Molybdenum Company Division of American Metal Climax, Inc. has committed \$40,000,000 for a five-year program of deep development of its Climax molybdenum mine to insure maximum production. Most of the money will be spent on preparing the third level for production and building necessary surface facilities. The third level is 500 feet below the lowest (Storke) mining level and is reached through an underground shaft and is to be reached through a new production shaft now being sunk at the Storke level portal. Robert Henderson is manager of Climax's western operations.

Standard Metals Corporation has started a comprehensive geological survey of its properties in San Juan County, Colo-

rado. Three field parties of geological and geophysical engineers will be under the direction of Charles A. Steen, vice president, exploration and development. Initial work will center in the **American Tunnel** area and will then be extended to include the **New Mar** properties which include the **Mountain Monarch** mine. Standard has completed its low level cross cut American Tunnel to cut the Belle Creole and Washington veins 300 feet below the old "T" or bottom level of the **Sunnyside** mine and 10,305 feet from portal. The raise to connect with old Sunnyside workings (11,000-foot elevation) has been completed from the breast of the American Tunnel (10,652-foot elevation). Drifting on the Washington Hanging and Footwall veins and the Belle Creole vein is being continued. Diamond drilling below American level is scheduled. Ore mined during development is being stockpiled at the **Shenandoah** mill north of Silverton.

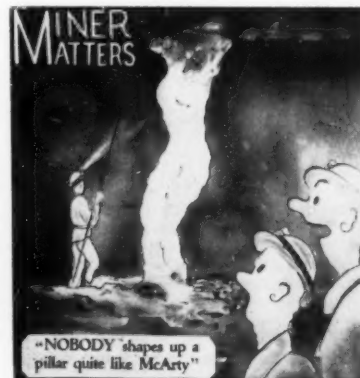
A new contract from the United States **Atomic Energy Commission** provides for purchase of \$20,700,000 worth of uranium concentrate from **Trace Elements Corporation**, a unit of **Union Carbide Corporation**. Trace Elements operates a 250-tons-per-day processing plant at Maybell, Colorado. The new contract, replacing one that would have expired March 31, 1962, provides for delivery of 656,000 pounds of U₃O₈ between January 1, 1961 and April 1, 1962, and 1,853,071 pounds between that date and December, 1966.

The **Atomic Energy Commission** is now updating its uranium ore reserve figures. These reserves were estimated at 81,000,000 tons as of January 1, 1961.

Eastern

Anaconda-Jurden Associates, Inc., the engineering and industrial design subsidiary of **The Anaconda Company**, has been purchased by **The Ralph M. Parsons Company**, a Los Angeles engineering-construction firm. Offices of the **Parsons-Jurden Corporation**, as the new firm is to be called, will remain at its present location, 26 Broadway, New York City. Parsons-Jurden will be operated as a subsidiary of The Ralph M. Parsons Company.

The Foote Mineral Company of Kings Mountain, North Carolina, has made a complete study of the spodumene content of its lithium ore reserves, and present estimates indicate a total of 20,746,297



tons of ore averaging 1.53 percent Li_2O . This estimate is 55 percent higher than previous ones, and does not take into consideration an additional estimated reserve of 15,769,075 tons believed to exist beneath adjacent properties.

New Jersey Zinc Company's major expansion program to double the production capacity of titanium dioxide at its Gloucester City, New Jersey, plant is virtually completed. Almost every operation in the complex chemical system of making pigment at the plant has been expanded in capacity. New equipment includes precipitation tanks, grinding mills, filters, dryers, and an additional 175-foot rotary calciner.

Appalachian Sulphides copper mine, located at Ore Knob near Jefferson, North Carolina, produced 10,875,566 pounds of copper, 1,694 ounces of gold, and 23,300 ounces of silver during 1960. The mine is now on a salvage basis, and will continue to operate through 1961 as long as copper prices remain at the present level. A total of 31 stopes extending down to the 1120 level have been mined out.

International Minerals & Chemical Corporation will build a \$3,800,000 diammonium phosphate plant and associated facilities at its chemical plant at Bonnie, Florida, according to general manager Floyd B. Bowen. Construction will start almost immediately with **D. M. Weatherly Company** of Atlanta as contractor for the basic production plant, and **Wellmann-Lord Engineering, Inc.** of Lakeland, Florida, handling the construction of storage, shipping, and other facilities.

Virginia-Carolina Chemical Corporation is expanding the storage facilities at its recently completed calcining plant at Nichols, Florida. The contract for the construction of the additional storage bin for calcined phosphate rock was awarded to **Wellman-Lord Engineering, Inc.** of Lakeland.

Idaho

Start of gold dredging operations in Idaho's Florence Basin is planned for July 1 by **Idaho Mining and Milling, Inc.**, which is completing assembly of a large dredge. Philip W. Jungert, Lewis-ton, is president and general manager.

The **Conjecture Mines, Inc.** shaft at the southern end of Pend Oreille Lake, Idaho Panhandle, has been deepened more than 600 feet in the last three months and a station is being cut at the 1,600-foot point. The shaft will be extended to the 2,000 level. **Federal Resources, Inc.**, Salt Lake City, is the operating firm.

Idaho Mining & Milling, Inc. has completed purchase of concentrating equipment for the outfitting of its No. 2 Yuba bucket line gold dredge located at the corporation's gold properties in the Florence Basin of Idaho County. The dredge will handle 2,000 cubic yards of gravel per day, and is expected to be operating by early July. The corporation owns over 40 miles of gold-bearing streambed in the Florence Basin which has never been worked by modern dredging equipment.

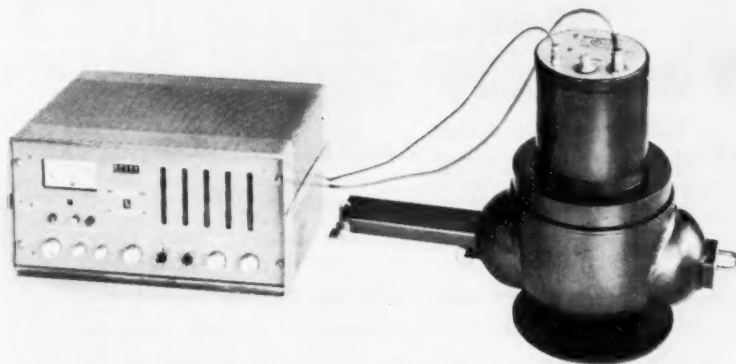
The three-year-old phosphate plant of **The Anaconda Company** will be moved shortly from Anaconda, Montana, to Pocatello where it will add to expanded output by **J. R. Simplot Company**. **Austin Company** of Seattle, Washington, who has the contract to move the plant, is expected to start dismantling shortly. Simplot is acquiring the Anaconda facilities to add an ammonium phosphate unit and increase phosphoric acid production at Pocatello.

Lucky Friday Silver-Lead Mines Company has acquired **Hecla Mining Company's** 37½ percent interest in the nearby **Silver Mountain** property. Hecla discontinued exploration of Silver Mountain in October, 1959, following failure to find appreciable mineralization. Lucky Friday

may make use of the 2,000-foot Silver Mountain shaft and underground facilities in eventual exploration of its Jutila ranch property adjoining Lucky Friday ground on the east. Lucky Friday is preparing the 2,800-foot level of its mine east of Mullan, Idaho, for production. Production in 1960 totaled 133,724 tons of ore averaging approximately 20 ounces of silver, 11 percent lead and 1 percent zinc to the ton. Ore reserves are estimated at nearly 1,300,000 tons.

Diamond drilling exploration is planned by **Clayton Silver Mines, Custer County, Idaho**, along with development of the North ore body on the new bottom 800-foot level. The ore body was cut where expected, 1,200 feet north of the shaft and advanced in very good lead-

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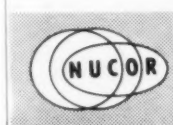
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zinc-silver ore for 140 feet and in low-grade for the next 300 feet over a 40-foot width. Production is running nearly 3,000 tons of ore monthly. Norman M. Smith of Kellogg, Idaho, is general manager; W. M. Yeaman, Yakima, Washington, president.

Continued operation of the Silver Summit mine, Shoshone County, Idaho, throughout 1961 has been assured by development of extensions of known ore shoots between the 2,500 and 3,000-foot levels. Production in 1960 totaled 27,133 tons of ore averaging nearly 32 ounces of silver and 1 percent copper per ton. The mine is owned and operated by Hecla Mining Company, of which L. J. Randall, Wallace, is president.

Iron Ranges

Hanna Mining Company has acquired the lease for the Mahnomen open-pit mine on the Cuyuna Range in Minnesota from Pickands Mather & Co., former operator. Ore sizing facilities have been installed and mining is expected to begin shortly. The Mahnomen mine was originally opened in 1915, and first manganiferous ore was shipped in 1916.

Domestic iron ore production during February 1961 amounted to 3,268,000 long tons. Shipments were 1,137,000 tons. Of this amount the Lake Superior region produced 2,049,000 long tons or 62.7 percent of the monthly total compared with 2,150,000 tons in January and 2,326,000 tons in February of last year. Output from Minnesota was 1,136,000 tons; from Michigan, 806,000 tons; and from Wisconsin, 107,000 tons.

Erie Mining Company will suspend its taconite operations at Hoyt Lakes, Minnesota for two weeks beginning July 9. During the two-week shutdown, the company will complete maintenance work that normally cannot be done while the plant is operating. In addition to the Hoyt Lakes plant, Erie has also scheduled maintenance work for the ore loading dock and power plant at Taconite Harbor on the shore of Lake Superior.

The M. A. Hanna Company's new Reduction Roasting Pilot plant at Cooley, Minnesota is now in full operation. The plant is on a round-the-clock basis and from data collected from the operation, it is anticipated that a decision can be made as to the feasibility of reduction roasting as a form of treating the semitaconite ores of the western Mesabi Range. The kiln, which is 85 feet long by 8 feet in diameter, is designed to treat approximately 10 tons per hour of ore. Plant feed is approximately 30 tons per hour and a coarse heavy-media concentrate is made prior to the reduction roasting step. Following reduction roasting, the artificial magnetite produced is recovered through a conventional magnetic separation circuit. Gas for the kiln is manufactured at the pilot plant from coke.

The construction contract for Oliver Iron Mining Division's new Pioneer washing plant near Ely, Minnesota has been awarded to Western-Knapp Engineering Company of San Francisco, California. Construction will start immediately and the plant is scheduled to be in full operation later in the summer. This plant is somewhat unique in that it will be the

only year-round operational washing plant on the Mesabi Range.

The Minnesota Legislature has held a special session to consider, among other things, the passage of a constitutional amendment in the State of Minnesota which would, in effect, guarantee that the taconite producers of Minnesota would not be taxed at a higher rate than are other industries in the state. During the regular legislative session the bill was not acted upon. The bill has the support of most of the people of northeastern Minnesota, but has had difficulty getting support of the Minnesota population that is situated outside of the Iron Range area. Passage of a bill in this special session to effect a constitutional amendment might possibly result in the construction of a \$400,000,000 taconite mill on the Mesabi Range in the future by United States Steel Corporation. If passed, the people of Minnesota will vote upon the measure in the November 1962 general election.

Montana

A thorough bedrock testing program has been undertaken on a 38-claim placer on the Vermilion River east of Thompson Falls, Sanders County, by a newly organized Spokane firm, **Vermillion Gold, Inc.**, with the object of dredging the ground. The work is being directed by Joe Meyer, Grangeville, Idaho, mining engineer. Frank H. Duvall and his son, Frank D., of Spokane head the firm.

The **Anaconda Company** has erected a high wooden fence on the east side of the **Berkeley** pit. Its purpose is to deaden the noise of trucks and heavy equipment. The fence is composed of different types of test sections. One 108-foot section is 16 feet high with a six-foot overhang. Another 100-foot section is a pleated design. Nine hundred feet is a straight board fence. The wooden fence meets a high wall of waste which completes the sound-barrier project. The company reports that the fence and waste berm are very effective in noise reduction.

A talc deposit 2,000 feet long and 800 feet wide, formed by the replacement of marble, is reported south of Ennis in the Cherry Creek area of Madison County, Montana. It is described in a new publication of the Montana Bureau of Mines and Geology.

The **Nancy Lee** lead-silver-copper mine near Superior is now producing some 70 tons of ore a day with 13 men underground and in the mill. Good ore has reportedly been found on the new 150-foot level.

At the annual stockholders meeting of **The Anaconda Company**, chairman of board, Clyde E. Weed, stated that the **Anaconda Aluminum Company** is now operating at 100 percent capacity and at a profit. He thought the long-range outlook for copper was good and was optimistic about the company's position. President Charles M. Brinkerhoff reported on the Butte program and outlined plans the company is taking to keep Butte a profitable operation.

The **New Departure** silver mine near Dillon is being opened by **Spokane National Mines Inc.** with a planned production of approximately 125 tons a day to be processed at the company's mill at

Bannack. Most production will come from known reserves among old mine workings.

Nevada

The **Anaconda Company** is carrying out a major development program for beryllium minerals at the leased mine of **Mt. Wheeler Mines, Inc.** south of Ely, Nevada. Anaconda board chairman Clyde Weed is reported to have said that an ore reserve of "a million or so tons" would be necessary for Anaconda to consider the property worthy of major attention. Anaconda took a lease and option on the mine late in 1960 and since that date has rehabilitated the **American Tunnel** and workings in an adjoining tunnel and carried out a major drifting, cross cutting, and raising program. George Lynn is Anaconda geologist at the mine and supervises work contracted to **Centennial Development Company**. The tunnels were driven several years ago in the search for lead, zinc, and tungsten and the operators at that time were not aware of the rare beryllium silicate, phenacite, in the ore.

Kaiser Steel Company has been buying high grade iron ore from miners in Pershing County, Nevada for its Fontana, California steel mill. A 10,000-ton iron shipment was completed in June by the **Nevada Iron Ore Company** and **Dodge Construction Company** which pooled production to fill the order.

Expansion of **Basic, Incorporated** during 1960 included a new refractory mill, rotary kiln, flotation mill, storage silos, crushing and screening facilities, and new bagging and warehouse facilities. One of Nevada's major producers of non-metals, Basic operates mines and processing plants at Gabbs in Nye County. The new kiln, 225 feet long, reduces magnesite briquettes to clinker, and the 500-ton-per-day flotation mill produces magnesite concentrates for kiln feed. (See **MINING WORLD**, November 1960, page 30)

A promising copper prospect in the Tempiute districts of Lincoln County, Nevada has been reported by E. U. Schofield of Provo, Utah. The mining claims are adjacent to property of **Wah Chang Corporation**. That firm formerly operated the Lincoln tungsten mine and mill at Tempiute, but closed it in 1957.

A million man-hours without a disabling injury is the record recently achieved by men of the reduction plant of **Nevada Mines Division, Kennecott Copper Corporation**, at McGill. The new record tops the previous mark of 637,233 by almost 400,000 man-hours at last report. During 1960 that division made its best record in the more than 50 years it has been in operation. Daily production of the division is 21,500 tons of ore and 40,000 tons of waste.

Mines Contracting, Inc., of Wickenburg, Arizona, is working at Lone Mountain in Nye County, Nevada, under contract with **Gold Eagle Mining Company**. The Arizona firm is also making steady progress in a crosscut at Gold Hill in the Divide district. Ike Kusisto directs operations of **Mines Contracting** and William de Carbonel is geologist and engineer for both properties.

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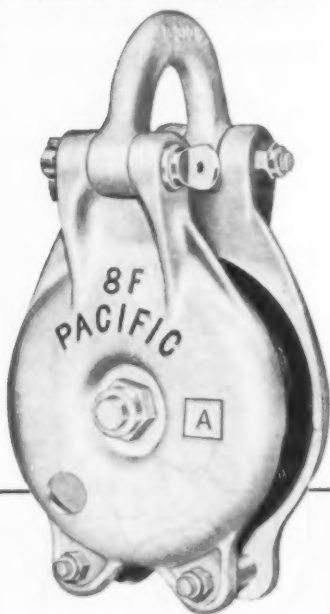
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silver-lead mine in the Eureka mining district of Nevada continues to show encouraging results. Direct smelting ore has been shipped from the mine for the last six years.

New Mexico

The annual **Rocky Mountain Mineral Law Institute** will be held at the University of New Mexico this year from July 27th through the 29th. Twenty speakers will discuss mineral law with emphasis on the effects of conservation laws, and the leasing of public lands.

Ore mining rate at **Duval Sulphur and Potash Corporation's** new potash mine north of its flotation mill is being increased as more mining faces are being opened up. First ore was shipped by railroad to the mill during May. **Winston Brothers Company** sunk two vertical circular shafts to the ore bed, but Duval is doing its own mining. **Stearns-Roger Manufacturing Company** of Denver, Colorado designed the surface plant. J. E. Tong is resident manager.

The new **Gnome** shaft of the **United States Atomic Energy Commission** at the Carlsbad, New Mexico detonation site in salt was sunk 361 feet in one month by the **Cementation Group of Companies**. This is claimed as a record for the Carlsbad Basin for any size shaft as the old record was 300 feet. The Gnome shaft is circular, 10 feet in diameter.

Banner Mining Company's development program at the **Bonney-Miser Chest** copper mine at Lordsburg, New Mexico has resulted in additional ore discoveries. The shaft has been deepened to a depth of 1,560 feet.

Despite delays last year resulting from a collapse of the shaft, **Rare Metals Corporation of America** expects by mid-year to reach its maximum production rate of 400 tons of uranium ore per day at its **San Mateo**, New Mexico, uranium mine. The development program is now on an 24-hour basis, with production increasing steadily. This program was near completion in March 1960 when the upper portion of the vertical shaft collapsed, apparently because of unusually heavy precipitation which saturated the sand formation constituting the walls of the upper 70 feet of the shaft to create more pressure than the timbers could withstand. The collapse caused tons of material to pour in, severing pump and electric lines and plugging the shaft with debris. Fortunately, large pieces of material wedged against the shaft sides to form a bridge about 220 below surface, and prevented debris from falling to the bottom of the shaft at 1,100 feet. No one was injured in the accident because the men were taken out through a newly completed escapeway and ventilation shaft. In rehabilitation, submersible pumps lowered into this shaft prevented flooding of the pump station and transformer units. By July 10 the shaft was repaired and reinforced so that all flood water could be pumped out. Because water damage to the main haulage level was so extensive, a new haulage level was driven in a sandstone formation that is relatively dry. By the end of the year some 2,100 feet of new haulage level had been driven, additional ore developed and shipments of ore to an Ambrosia Lake area mill resumed.

Oregon

With a final cash payment to the government of \$1,722,000, the purchase terms for the nickel smelter at Riddle were completed in April by **Hanna Mining Company**, who has been operating it for the federal government since 1955. Under terms of a contract negotiated in 1952, Hanna purchased the plant for about \$24,000,000 in cash and nickel which was sold to the government's account or placed in the strategic materials stockpile. The acquisition has made Hanna the sole domestic producer of nickel used in making steel alloys. Due to increasing demand for stainless steel and other nickel-bearing steel alloys, Hanna expects to be able to sell all its production of some 22,000,000 pounds of nickel annually.

The **Office of Minerals Exploration** has entered into a \$54,000 contract with **Emerald Empire Mining Company** of Cottage Grove to drive a 1,200-foot adit on the **Musick** lead-zinc-copper vein in the **Bohemia** District in Lane County. **Emerald Empire** is leasing the ground to be explored with **Lane Minerals Company**, and both parties are contributing equally on the adit work. The portal of the new adit will be 335 feet below the No. 6 level of the **Musick** mine, which was discovered in 1891 and is one of the oldest properties in the area.

Processing of millions of tons of low grade iron-bearing sands at the mouth of the **Columbia River** is the goal of newly incorporated **Northwest Iron and Steel Company** of Tacoma, Washington. An Oregon House of Representatives committee has reported favorably on a bill which would authorize Oregon to lease **Columbia River** delta lands for mining. The recent Washington legislature passed legislation permitting leasing of delta lands on the Washington side of the river.

South Dakota

Homestake Mining Company mined the greatest yearly tonnage of ore—1,767,135 tons—in history at **Lead** during 1960. Despite this large tonnage mined the ore reserves above the 5000-foot level totaled 13,727,000 tons with a per ton dollar value of \$12.35 on January 1, 1961, compared with 13,872,000 tons of \$12.40 ore a year earlier. While development below the 5,000 level and to the 6,200-foot level was disappointing, exploration in the folds of the **Homestake** formation well between the 3,650 and 5,900-foot levels to the west of any previously known ore occurrences has shown good values. Extensive exploration of these areas will be undertaken from existing mine workings. Exploration for the **Nine Ledge** on the 6,200 level was disappointing, but good ore was found in the **Main Ledge** on the same level. However, the **Main Ledge** ore was smaller than on 5,900 yet larger than on 5,600. The company's engineers figure there is at least 2,500,000 tons, and possibly more, ore of average grade in this deep block. This tonnage warrants preparation for mining 800 tons per day and the mill capacity is being raised by that amount by the installation of another grinding circuit. **James O. Harder** is **Black Hills** manager.

Susquehanna Operates First Texas Uranium Mill

The first uranium mill in Texas is now operating at capacity reports G. H. Bryant, manager of Susquehanna-Western, Inc.'s, metallurgical division.

The 200-ton-per-day mill located 60 miles south of San Antonio, is specially designed to handle locally produced ores having a high bentonite and moisture content. The process consists of calcining, acid leaching, counter current decantation washing, and solvent extraction for recovery of uranium. Ore to be processed is principally derived from company mines in South Texas.

Susquehanna executed the Atomic Energy Commission contract on July 25, 1960. The mill, involving an investment of approximately \$2,000,000, was designed and constructed by the company. Process design and general arrangement was by H. L. Hazen, Inc., of Denver, Colorado. Design capacity of the plant was achieved during the first day and uranium concentrate was produced on the third day.

Susquehanna-Western also operates a custom uranium-vanadium mill at Edgemont, South Dakota, and a custom uranium mill at Riverton, Wyoming.

Utah

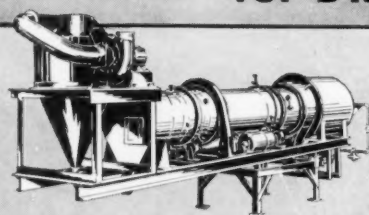
Hecla Mining Company has completed mining of the Hot Rock ore body at its Radon uranium mine in the Big Indian district south of Moab, Utah. Hecla will now centralize mining operations at the Radon to meet its ore shipping quota at the Uranium Reduction Company mill. During the first quarter 13,511 tons of ore assaying 0.678 percent U_3O_8 were mined. Phil Lindstrom is superintendent.

The Garfield, Utah electrolytic copper refinery of Kennecott Copper Corporation, completed one year of operation on June 5th without a disabling injury. More than 1,700,000 man hours of injury-free operation have been completed. J. P. O'Keefe is Utah Division general manager.

Minerals Engineering Company-Susquehanna Western Inc.'s joint venture to produce vanadium as a byproduct of elemental phosphorous smelting is scheduled to start at the old Calera cobalt refinery at Garfield in August at an annual rate of 1,000,000 pounds. While the western phosphoria formation has long been known to contain small amounts of vanadium this will be the first plant to recover it from electric furnace matte. The Anaconda Company for a number of years recovered vanadium as a phosphate fertilizer byproduct at its Anaconda, Montana plant. Matte from the Pocatello, Idaho smelter of Food Machinery and Chemical Corporation is shipped to Garfield for refining.

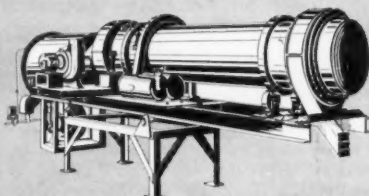
Harrison International of Miami, Florida, an affiliate of Patrick A. Harrison and Company of Canada, is starting to sink the 2,800-foot deep production shaft for Utah Potash Company at Cane Creek, Grand County, Utah. Harrison was the successful bidder of 16 firms seeking to sink this new 22-foot diameter concrete lined shaft to develop the new mine. The 168-foot high prestressed concrete headframe and 70-foot deep concrete

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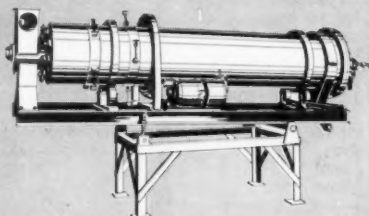
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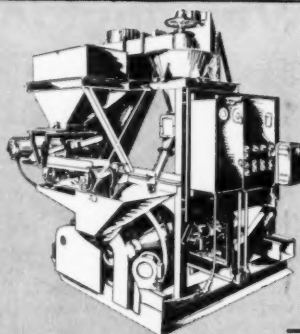
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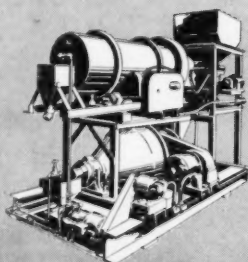
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collar of the shaft have been completed by Stearns Roger Manufacturing Company of Denver, Colorado. Stearns has the design and erection contract for the surface plant and 12,000 daily ton flotation mill. The Harrison contract calls for sinking the shaft, cutting a major station at the 2,750-foot level, and driving two main haulage drifts 16 feet wide and 8 feet high 3,000 feet southwesterly from the shaft to the top of the ore body. Room and pillar stoping will be used with ore transported to shaft on rubber conveyor belts. A 39-mile-long branch line of the Denver and Rio Grande Western Railroad Company is now being built from the mine to the main line at Thompson. Utah Potash is a division of Texas Gulf Sulphur Company.

The Barber Mining Company has reopened its Rex No. 1 uranium mine on Elk Ridge, San Juan County, Utah, after a rock slide had buried the portal and damaged an air compressor. The mine had been closed for the winter when the slide occurred. Myron Barber is superintendent.

Western Contracting Corporation has completed stripping of 8,000,000 cubic yards of waste from the east side of Kennecott Copper Corporation's Bingham Canyon open pit mine and has moved stripping equipment to the west side. About 4,000,000 cubic yards will be stripped here to complete the largest stripping contract the Utah Copper Division has ever awarded to an independent contractor. Western Contracting has increased equipment capacity for this job by using a 13-cubic-yard light weight bucket on a 10-yard shovel and building a special 150-ton capacity end dump truck powered by two 450-horsepower Diesel motors.

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Mining Claim Status Under The Small Tract Act

H. J. Vander Veer and Associates, public land consulting engineers of Salt Lake City, Utah have reported the following Interior Secretarial decision regarding mineral locations on public lands.

Mining claims on lands subject to small tract act. Generally where land is classified as suitable for disposition as a small tract pursuant to an application filed by an applicant who gains a preference right to a lease or purchase of the tract as a result of the classification, a mineral location made after the application was filed but before the land was classified becomes invalid.

The fact that land is covered by a small tract application or that the Department on its own initiative is considering it for disposition as a small tract does not remove it from mineral location.

Where the land office has been notified that land is under consideration for small tract purposes prior to the filing of a small tract application, the land remains open to mineral location and a later small tract classification will not render invalid an otherwise valid mining claim located prior to that classification.

Further, in the solicitor's decision it is stated: "In summary then a mineral location made after a small tract application has been filed for the same land is not invalid per se, and the locator can protest against the classification of the land for small tract purposes, but if the land is classified for disposition as a small tract, the mining claim must then be held invalid".

Washington

Helicopter exploration for mineral deposits has been ruled out in the Glacier Peak Wilderness Area of Snohomish County except on the few mining claims previously located and Bear Creek Mining Company is curtailing its exploration activities. The exploration subsidiary of Kennecott Copper Corporation has been testing the isolated Glacier Peak mining property for several years by helicopter air lifts and diamond drilling has outlined a major copper deposit. Present Forest Service regulations permit mine access road construction to mining claims now held, but the proposed National Wilderness System bill would prohibit road building in Wilderness areas. Rob-

ert D. Hutchinson, Spokane, is Northwest district geologist for Kennecott.

Goldfield Consolidated Mines Company is exploring the Schumaker zinc-lead mine on Joe Creek north of Colville, Stevens County, under an option to acquire control from Triton Mining Company. Work was on a three-shift basis at last report. Triton began exploration of the property a year ago and in extending an old hand-driven tunnel intersected a deposit of ore. Goldfield stepped in after Triton had opened the ore body over widths of 8 to 10 feet over a distance of 300 feet, with values estimated at from 8 to 12 percent combined lead-zinc. Darrell A. Newland, Colville, is president of Triton.

The contiguous mining properties of Meteline Contact Mines, The Bunker Hill Company and Day Mines, Inc., in Pend Oreille County's Meteline District have been consolidated. Meteline Contact, largely owned by the two other firms, now has holdings extending from south of Meteline Falls to the Canadian border, a distance of about 13 miles. It increased its capital stock and issued shares to Bunker Hill and Day Mines for their holdings. They also accepted stock in settlement of more than \$200,000 worth of notes, advances and interest. Charles E. Schwab, Kellogg, Idaho, is president of Meteline Contact.

The Olympic National Park coastline will be mapped geologically this summer by William L. Wilkerson, assistant geology professor at Eastern Washington College of Education, Cheney, under a United States Park Service grant.

Pend Oreille Mines and Metals Company has substituted long-hole drilling for diamond drilling in exploration and development work at its Pend Oreille zinc-lead mine, northern Pend Oreille County. Costs have been reduced from \$2.80 a foot to \$0.37 a foot. The firm currently is employing 173 in mine and mill. Jens Jensen, Spokane, is president.

Installation of a cyanide addition to its flotation mill is planned this year by Western Gold Mining, Inc., at its property in Hart's Pass, Whatcom County, Washington. Substantial savings in freight and smelting charges should be effected by cyanide treatment of flotation concentrates. A 1960 diamond drilling program indicated average values of one-third of an ounce of gold per ton. Walter M. Stephen, Seattle, is mill consultant, and Harry P. Kramer, Seattle, president.

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Lane Mountain Silica Company is testing equipment at its new \$500,000 silica plant at Valley, Stevens County, Washington. At full production, 400 tons of silica is expected to be produced daily. The product will be shipped to industries on the Pacific Coast and in Canada. The firm's open pit mine is 10 miles west of Valley. Charles Smith is plant superintendent.

A second edition of a comprehensive inventory of nonmetallic minerals of Washington is now available, according to Earle Coe, director of the Washington Department of Conservation. This is a revision of Part I of Division of Mines and Geology Bulletin 37 published in 1949. Many more references to earlier reports on the occurrences listed in the first edition are contained in the new version. The two-volume bulletin with the text in one part and the maps in the other may be purchased for \$3.00 per set from the Department of Conservation, 335 General Administration Building, Olympia, Washington.

Wyoming

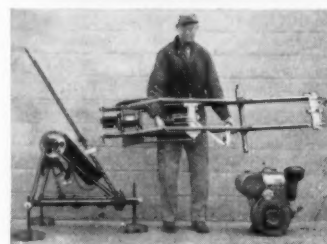
Hidden Splendor Mining Company of Salt Lake City, Utah, has leased the Sunlight copper-silver claims of Skyline Corporation in Park County, Wyoming. The claims are in the Sunlight Basin of the Absaroke Mountains about 40 miles east of Yellowstone Lake. Hidden Splendor has geologists in the area now and their findings will determine the extent of further work. Other mines in the Basin have produced lead-silver ore in the early 1950's. Skyline's headquarters are in Powell, Wyoming.

Construction of Columbia Geneva Steel Company's new taconite mill at Atlantic City, Wyoming is on schedule with more than 1,250 men employed. The steel framework for the crushing and screening plant was completed in early June and the first of the 100-foot-long steel trusses were installed in the grinding and magnetic separation building. The railroad from Winton Junction to the new mill is advancing at about 10 miles per week and is scheduled for completion in early August.

The manway and ventilation shaft at Stauffer Chemical Company's new Trona mine northwest of Green River, Wyoming has been completed to the ore body. Lateral development will connect with the main shaft now being sunk and concrete lined at the rate of 50 feet per week. Winston Brothers Company is sinking the shaft and building the concentrator. The 10-mile-long railroad to the new mine has been completed and freight shipments are now being made over it. This will be the district's second Trona mine.

Homestake Mining Company's sales of uranium ore from its Hauber mine on the northwest flanks of the Bear Lodge Mountains in northeastern Wyoming have been greater than the cost of developing the mine. Normal production of 8,000 tons of 0.23 percent U_3O_8 ore per month is being shipped to Mines Development Inc.'s Edgemont, South Dakota custom uranium mill. The Hauber mine is underground and is a wet mine, but mining has not been as difficult as in several of Homestake's Ambrosia Lake, New Mexico mines.

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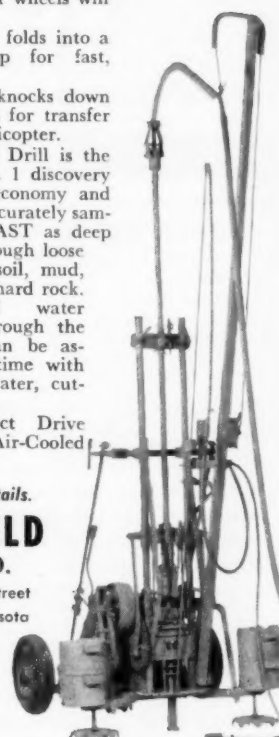
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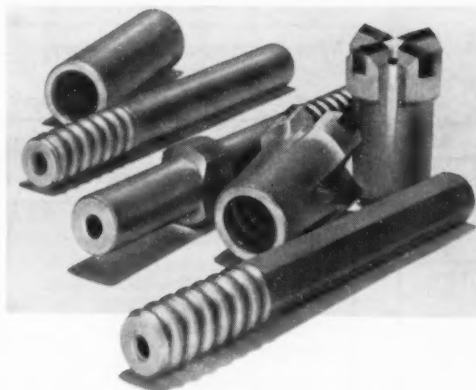
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- 8—48" Vulcan Denver, Cast Steel
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- 1—72" x 32" Wemco Spiral, 10 HP

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- 1—WN-4 Sullivan, 400 HP

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- 1—18" x 90', 7 1/2 HP Motor, Complete
- 1—18" x 44', Steel Frame, 5 HP
- 1—24" x 70', Pioneer Stacking

Crushers

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- 1—13-8 Telsmith Gyratory, 75 HP

Drills

- 5—H-10 Cleveland, w/6' Airlegs
- 2—K-89 Joy Paving Breakers
- 2—J-10 IR Jackhammers

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- 1—3/4 yd. P.&H., Model 255-A, w/Boom & Bucket

Fans

- 3—48" dia., Underground Type, 15 HP
- 1—Joy Axivane, 30 HP

Feeders

- 1—36" x 16' Marco Belt Type, 5 HP
- 1—24" Denver Cone Reagent, Complete
- 1—18" Denver Cone Reagent, Complete

Filters

- 1—6' - 3 Disc. Eimco, w/Filtrate Pump
- 1—6' - 4 Disc. Eimco, w/Filtrate Pump

Flotation Machines

- 2—6 Cell #5 Denver Equip. Co., Sub. A
- 4—3 Cell #21 Denver Equipment Co.
- 1—6 Cell #21 Denver Equipment Co.
- 1—8 Cell 44" Fagergren, 5 HP
- 3—2 Cell 56" Wemco, 15 HP
- 2—4 Cell 56" Wemco, 10 HP
- 1—5 Cell 56" Wemco, 10 HP
- 1—8 Cell 56" Wemco, 10 HP
- 1—2 Cell 56" Fagergren, 20 HP
- 4—4 Cell 56" Fagergren, 15 HP
- 1—Unit Cell, 56" Wemco, 10 HP

Grader

- 1—#112 Caterpillar

Hoists, Tugger or Slusher

- 4—D6U Ingersoll Rand, Air Tugger
- 4—EU Ingersoll Rand, Air Tugger
- 2—HU Ingersoll Rand, Air
- 6—30 MNM 3D Ing. Rand, 3 Drum, 440v
- 4—30 MNM 3D Ing. Rand, 3 Drum, 440v
- 1—20 MNM 3C Ing. Rand, 3 Drum, 440v

Hoists, Mine Shaft

- 1—150 HP Rogers, 1 Drum, 440v
- 1—250 HP Allis-Chalmers, 1 Drum, 8' dia. Drum, Post Brake; 2200v

Loaders

- 1—Eimco 630
- 1—Allis Chalmers "Tracto-Loader", TL6

Magnets

- 1—Dings Bi-Polar, Type 88
- 1—Dings Rectangular, 110v
- 1—Cutler Hammer, Suspended, Size 37
- 2—Dings Rectangular, Type 24RM100
- 1—Dings Drums Separator, 36" x 42" Drum Type

Mills, Ball

- 1—16" x 16" Denver, Less Motor
- 1—30" x 36" Denver, Less Motor
- 1—#64 1/2 Marcy, 100 HP
- 1—#86 Marcy, 250 HP
- 1—10' x 48" Hardinge, 400 HP

Mixers

- 3—"Lightnin", Type S-1, 1 1/3 HP
- 1—"Lightnin", Type D-2, 1/2 HP
- 1—Patterson Typhoon, 1/4 HP

Pulverizer

- 1—UA Braun, Motorized, 2 HP

Pumps, Sand

- 2—1" Denver Vertical, 3/4 HP
- 5—2" Denver Vertical, 10 HP
- 17—2" Wemco, Rubber & Iron Lined, 5 HP
- 5—3" Wemco, Iron Lined, 10 HP
- 8—4" Wemco, Iron Lined, 20 HP
- 2—6" Wemco, Iron Lined, 50 HP
- 1—8" Wemco, Iron Lined, 100 HP
- 1—6" x 8" Allis Chalmers, 100 HP
- 1—5" Denver Duplex Diaphragm

Pumps, Suction Pressure

- 3—3/4" Denver Equipment Co., 1/2 HP

Pumps, Centrifugal

- 1—2 MRV-40 Ing. Rand, 440v
- 3—Size 25W, LaBour, 15 HP
- 1—4" x 5" American-Marsh, 4 Stage, 60 HP
- 1—SH Byron Jackson, 75 HP
- 1—4" Amsco Nagel, 7 1/2 HP

Pump, Vacuum

- 1—22" x 9" Ing. Rand, ES-1, 40 HP

Samplers

- 1—16" Galigher, Automatic
- 6—21" Denver, Automatic

Screens

- 2—3' x 6' Allis Chalmers "Aerovibe", 3 HP
- 1—4' x 8' Symons Rod Deck, 7 1/2 HP
- 1—4' x 10' Tyler Ty-Rock
- 1—5' x 12' Allis Chalmers, Lowhead

Shovel

- 1—3/4 yd. P.&H Model 255-A, 1953

Scale

- 1—100 Ton Howe Railroad Track

Thickener

- 1—14' x 6' Dagley, Steel Tank

Tractors

- 4—DW-10 Caterpillar, Ore Hauler
- 3—HD-9G Allis Chalmers, w/Loader
- 2—T-200 Allis Chalmers, Ore Hauler

Weightometers

- 1—Merrick Model "E", 18" Belt
- 2—Merrick Model "E", 30-36" Belt

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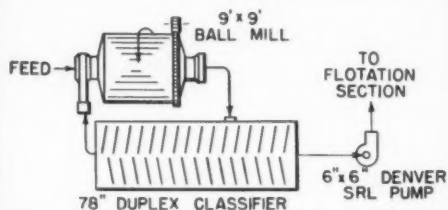
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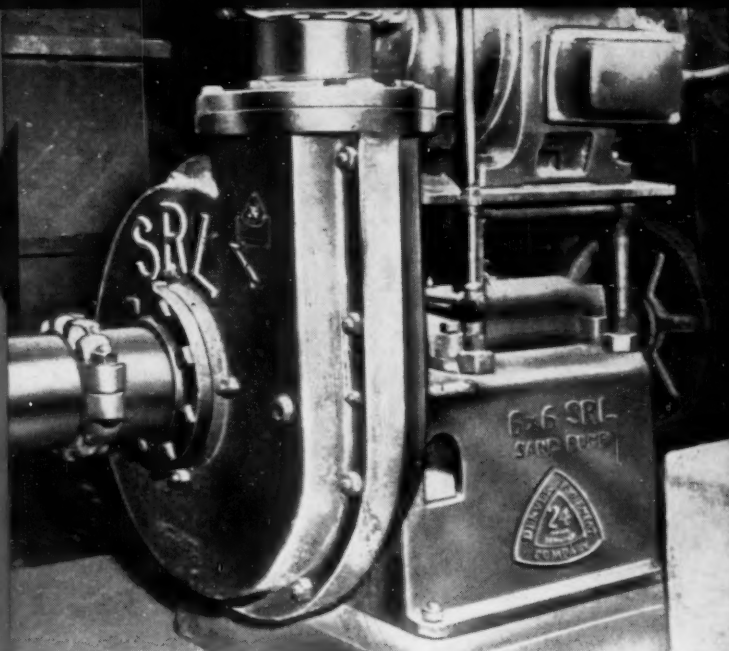
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DENVER SRL Pump at right (and shown in flow-sheet above) is operating at 739 r.p.m. handling 75 tons of solids per hour of -28 mesh classifier overflow of 40% solids. Wearing life of runner is in excess of 1,099,800 tons while the casing liners handle over 2,000,000 tons before replacement is required.



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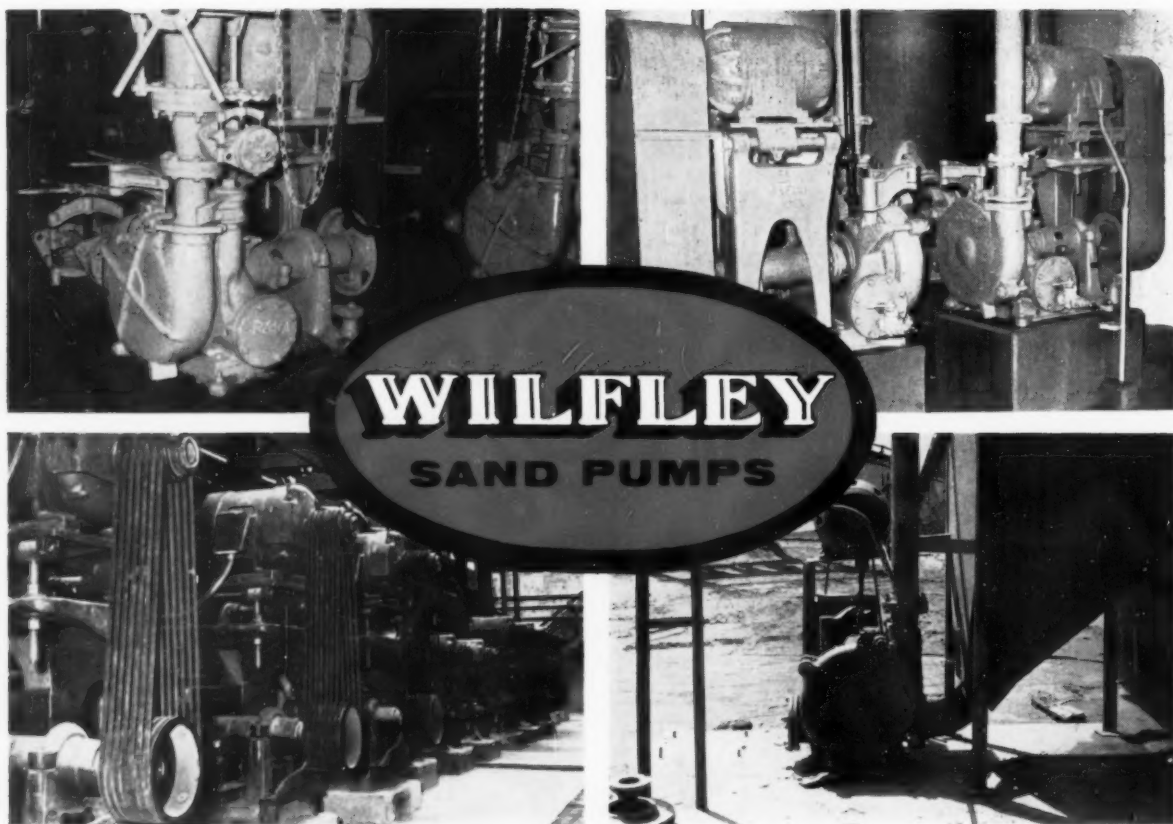


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